SR 95 CORRIDOR PROFILE STUDY

JUNCTION I-8 TO JUNCTION I-40

ADOT WORK TASK NO. MPD-041-15
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DRAFT WORKING PAPER 6: SOLUTION EVALUATION AND PRIORITIZATION

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PREPARED FOR:

ARIZONA DEPARTMENT OF TRANSPORTATION

PREPARED BY:

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ACRONYMNS & ABBREVIATIONS

ABBREVIATION	NAME
ADOT	Arizona Department of Transportation
CCTV	Closed Circuit Television
CPS	Corridor Profile Study
DMS	Dynamic Message Sign
I	Interstate
IRI	International Roughness Index
LCCA	Life-Cycle Cost Analysis
MP	Milepost
P2P	Planning to Programming
P2P Link	Planning to Programming Linkages
PES	Performance Effectiveness Score
PTI	Planning Time Index
PS	Prioritization Score
RWIS	Road Weather Information System
SR	State Route
TTI	Travel Time Index
TPTI	Truck Planning Time Index
TTTI	Truck Travel Time Index
VMT	Vehicle-miles Travelled
WIM	Weigh-in-Motion
YPG	Yuma Proving Ground

1.0 INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study (CPS) of State Route 95 (SR 95) between Interstate 8 (I-8) in Yuma and Interstate 40 (I-40) north of Lake Havasu City. This study will look at key performance measures relative to the SR 95 corridor, and the results of this performance evaluation will be used to identify potential strategic improvements.

The intent of the corridor profile program, and of the Planning to Programming (P2P) process, is to conduct performance-based planning to identify areas of need and make the most efficient use of available funding to provide an efficient transportation network. ADOT is conducting eleven corridor profile studies. The eleven corridors are being evaluated within three separate groupings.

The first three studies (Round 1) began in spring 2014, and encompass:

- I-17: SR 101L to I-40
- I-19: Mexico International Border to I-10
- I-40: California State Line to I-17

The second round (Round 2) of studies, initiated in spring 2015, includes:

- I-8: California State Line to I-10
- I-40: I-17 to the New Mexico State Line
- SR 95: I-8 to I-40

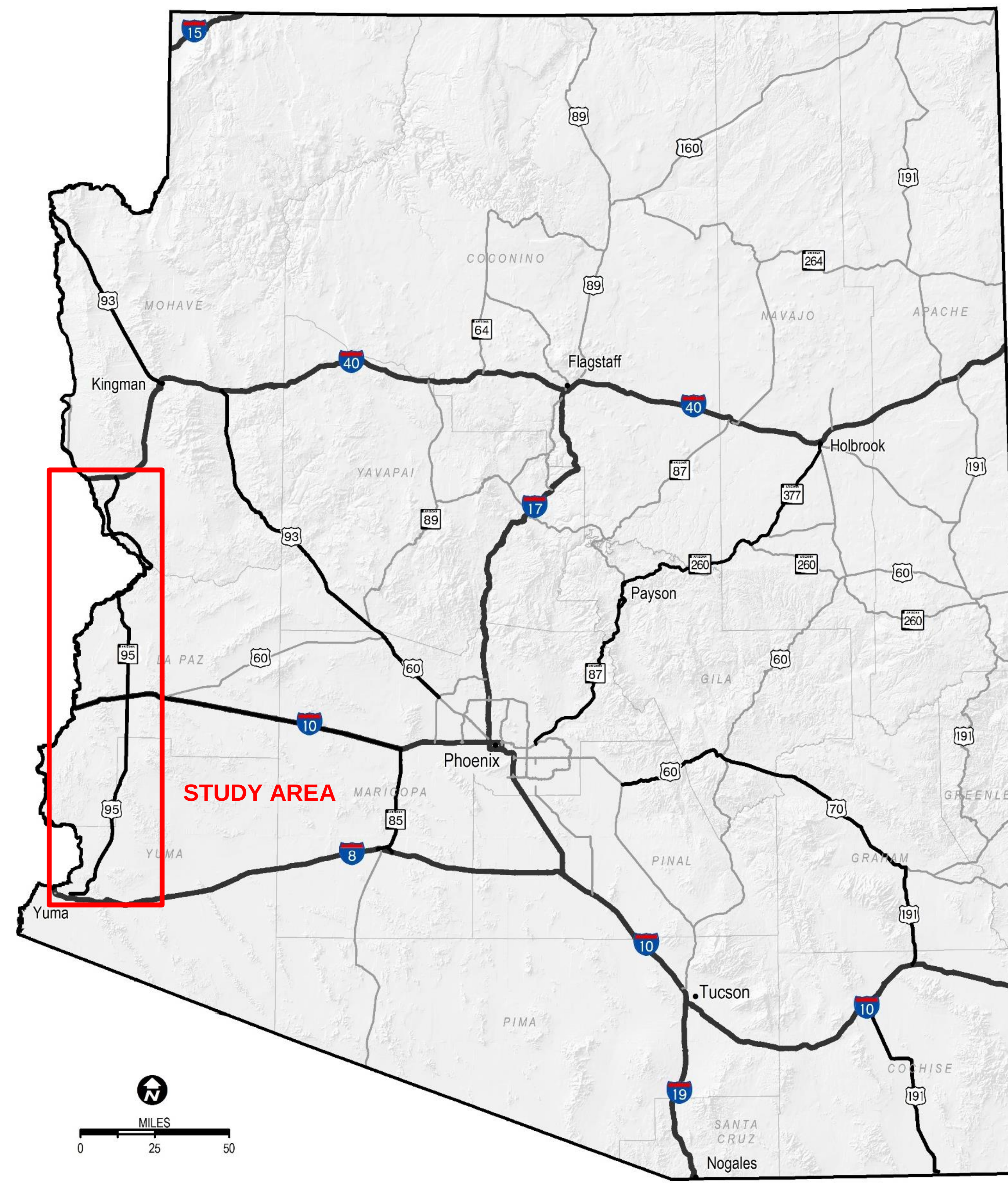
The third round (Round 3) of studies, initiated in fall 2015, includes:

- I-10: California State Line to SR 85 and SR 85: I-10 to I-8
- I-10: SR 202L to the New Mexico State Line
- SR 87/SR 260/SR 377: SR 202L to I-40
- US 60/US 70: SR 79 to US 191 and US 191: US 70 to SR 80
- US 60/US 93: Nevada State Line to SR 303L

The studies under this program will assess the overall health, or performance, of the state's strategic highways. The Corridor Profile Studies will identify candidate solutions for consideration in the Multimodal Planning Division's (MPD) P2P project prioritization process, providing information to guide corridor-specific project selection and programming decisions.

SR 95, I-8 to I-40, depicted in **Figure 1**, is one of the strategic statewide corridors and the subject of this Round 2 CPS.

Figure 1: Corridor Study Area



1.1 Corridor Study Purpose

The purpose of the SR 95 CPS is to measure corridor performance to inform the development of strategic solutions that are cost-effective and account for potential risks. This purpose can be accomplished by following the process established by the previous Round 1 corridor profile studies to:

- Inventory past improvement recommendations.
- Define corridor goals and objectives.
- Assess existing performance based on quantifiable performance measures.
- Propose various solutions to improve corridor performance.
- Identify specific solutions that can provide quantifiable benefits in relation to the performance measures.
- Prioritize solutions for future implementation.

1.2 Corridor Study Goals and Objectives

The objective of this study is to identify a recommended set of potential strategic solutions for consideration in future construction programs, derived from a transparent, defensible, logical, and replicable process. The SR 95 CPS will define solutions and improvements SR 95 that can be evaluated and ranked to determine which investments offer the greatest benefit to the corridor in terms of enhancing performance.

The following goals have been identified as the desired outcome of this study:

- Link project decision-making and investments on key corridors to strategic goals.
- Develop solutions that address identified corridor needs based on measured performance.
- Prioritize improvements that cost-effectively preserve, modernize, and expand transportation infrastructure.

1.3 Working Paper 6 Overview

The objective of Working Paper 6 is to document the evaluation of the strategic solutions (projects) identified in Working Paper 5 for the SR 95 corridor. Pavement and bridge solutions will be evaluated using a Life-Cycle Costs Analysis (LCCA). In addition, this evaluation will include a risk-based performance effectiveness evaluation on each recommendation to determine the amount of benefit to the performance scores each solution produces. The result of this evaluation will be a prioritized list of recommendations for the SR 95 corridor.

1.4 Corridor Overview

The SR 95 corridor is a vital road link in the western part of the state, providing the only north-south link between I-8, I-10, and I-40. The US 95 portion of the SR 95 corridor runs between I-8 and I-10 and connects the cities of Yuma and Quartzsite while also providing a strategic connection to the U.S. Army Yuma Proving Ground (YPG) and General Motors Desert Proving Ground – Yuma. The SR 95 portion of the SR 95 corridor runs between I-10 and I-40 and connects the cities of Quartzsite, Parker, and Lake Havasu City. This corridor also serves and passes through the Colorado River Indian Reservation.

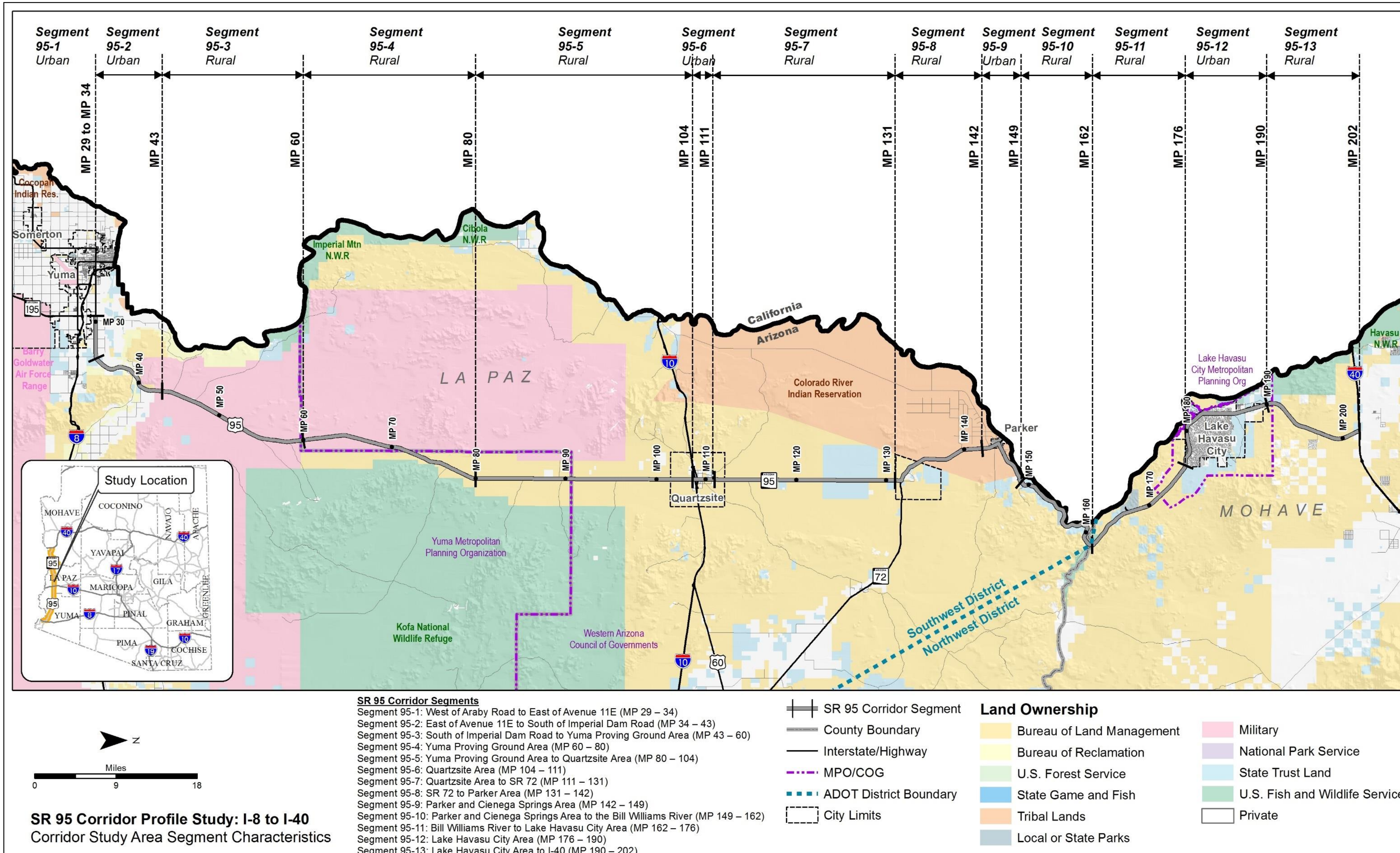
1.5 Study Location and Corridor Segments

The study area consists of segments of both SR 95 and US 95, however, for the purposes of this study, the study area is generally referred to as SR 95, except where noted in reference to a specific project. The SR 95 study corridor has been divided into 13 segments to allow for an appropriate level of detailed needs analysis, performance evaluation, and comparison between different segments of the corridor. These corridor segments are described in **Table 1** and shown in **Figure 2**.

Table 1: SR 95 Corridor Segments

Segment	Segment Begin/End Description	Approximate Begin Milepost	Approximate End Milepost	Approximate Length (miles)	Through Lanes	2014 Average Annual Daily Traffic Volume (vpd)	Character Description
95-A	I-8 to west of Araby Road	24	29	5	4	15,353	Non-ADOT facility (turned back to City of Yuma), traffic interchange (TI) with I-8; this Segment A will not be analyzed within the SR 95 Corridor Profile Study. Segment A is identified as it is a critical connection to I-8
95-1 (Yuma)	West of Araby Road to East of Avenue 11E	29	34	5	4	11,432	Beginning-point of ADOT facility, interrupted flow facility with four-lane cross-section, relatively flat terrain, transitioning urban/rural area, junction with Araby Road and Fortuna Road, private land ownership
95-2	East of Avenue 11E to south of Imperial Dam Road	34	42	8	2	7,221	Uninterrupted flow facility with a two-lane cross-section, rolling terrain, rural, Bureau of Land Management (BLM), Bureau of Reclamation (BOR)
95-3	South of Imperial Dam Road to Yuma Proving Ground Area	42	60	18	2	3,292	Uninterrupted flow facility with two-lane cross-section, flat terrain, rural, military land ownership (Laguna Army Airfield, YPG), General Motors Desert Proving Ground Yuma, junction with Imperial Dam Road
95-4	Yuma Proving Ground Area	60	80	20	2	1,584	Uninterrupted flow facility with two-lane cross-section, relatively flat terrain, rural, BLM, Kofa National Wildlife Refuge, military land ownership
95-5	Yuma Proving Ground Area to Quartzsite Area	80	104	24	2	1,750	Uninterrupted flow facility with two-lane cross-section, flat terrain, BLM, Kofa National Wildlife Refuge
95-6	Quartzsite Area	104	111	2.5	4	9,917	Interrupted flow with five-lane cross-section, urban area type within Quartzsite, private land ownership, BLM, State Trust land, junction with I-10, transition from US 95 to SR 95
95-7	Quartzsite Area to SR 72	111	131	20	2	2,357	Uninterrupted flow facility with two-lane cross-section, flat terrain, rural, BLM, State Trust Land
95-8	SR 72 to Parker Area	131	142	11	2	5,728	Uninterrupted flow facility with two-lane cross-section, flat, rural, BLM, State Trust land, Tribal land, junction with SR 72
95-9 (Parker)	Parker and Cienega Springs Area	142	149	7	4	12,349	Interrupted flow with five-lane cross-section, relatively flat with some grade variation, urban area type within Parker to Cienega Springs, private land ownership, Tribal land
95-10	Parker and Cienega Springs Area to Bill Williams Area	149	162	13	2	5,406	Uninterrupted flow facility with cross-sections varying from two lanes to four lanes, mountainous terrain, rural with some communities within the vicinity of the corridor, State Trust land
95-11	Bill Williams River to Lake Havasu City Area	162	176	14	2	5,127	Uninterrupted flow facility with two-lane cross-section, mountainous terrain, rural, BLM, U.S. Fish and Wildlife Service, State Trust land
95-12 (Lake Havasu City)	Lake Havasu City Area	176	190	14	4	17,771	Interrupted flow facility with five-lane cross-section, flat terrain, urban area type within Lake Havasu City and Desert Hills, private land ownership, State Trust land
95-13	Lake Havasu City Area to I-40	190	202	12	2	7,886	Uninterrupted flow facility with cross-sections varying from two lanes to four lanes, rolling hills terrain, rural, BLM, junction with I-40

Figure 2: Corridor Location and Segments



2.0 CANDIDATE SOLUTION EVALUATION PROCESS

Candidate solutions identified in Working Paper 5 will be evaluated in multiple ways including a LCCA (where applicable), Risk Analysis, and a Performance Effectiveness Analysis. The methodology and approach to this analysis is described in the following sections. **Figure 3** illustrates the candidate solution evaluation process.

2.1 Life-Cycle Cost Analysis

All pavement and bridge candidate solutions have multiple options: rehabilitate the area of need, or fully reconstruct the issue area or structure. These options will be evaluated through an LCCA to determine the best approach for each location where a pavement or bridge solution is recommended. The LCCA could eliminate options from further consideration and will identify which options should be carried forward for further evaluation.

After the LCCA, the remaining options will be advanced to the Performance Effectiveness Evaluation.

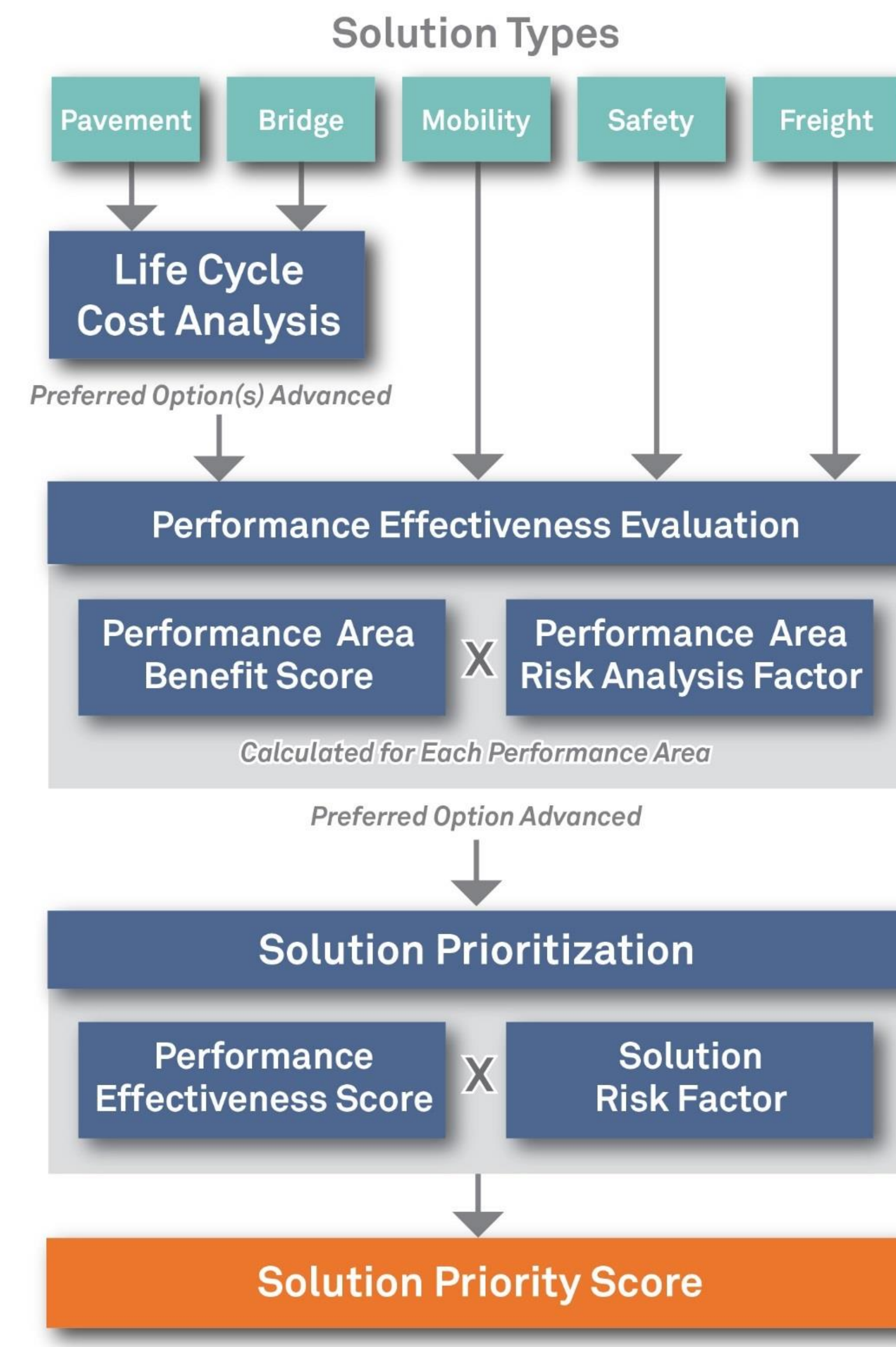
2.2 Performance Effectiveness Evaluation

After the LCCA process is complete, all remaining candidate solutions will be evaluated based on their performance effectiveness. This process will include determining a Performance Effectiveness Score (PES) based on how much each solution impacts the existing Performance and Needs scores for each project segment. This process is modeled after a benefit/cost analysis, with the benefits being measured in the performance system. This evaluation will also include a Performance Area Risk Evaluation to help differentiate between similar solutions based on factors that are not directly addressed in the performance system.

2.3 Risk Analysis

All candidate solutions that are advanced through the Performance Effectiveness Evaluation will also be evaluated through a Risk Analysis process. This process will examine the risk of not implementing a recommended solution in terms of overall corridor performance. The results of this analysis will be combined with the Performance Effectiveness scores to determine the highest priority solutions in the corridor.

Figure 3: Solution Evaluation Process



3.0 CANDIDATE SOLUTION EVALUATION

The principal objective of the CPS is to identify strategic solutions (investments) that are performance-based to ensure that available funding resources are used to maximize the performance of the State's key transportation corridors. The corridor profile process is intended to provide input to the P2P process and will assign strategic solutions to one of the three investment categories: Preservation, Modernization, or Expansion.

The performance system and performance needs previously documented in Working Papers 2 and 4, respectively, served as a foundation for developing strategic solutions for corridor preservation, modernization, and expansion.

Strategic solutions are not intended to recreate or replace results from normal programming processes. However, they should address elevated levels (high or medium) of need and focus on investments in Modernization projects to optimize current infrastructure. Ideally, strategic solutions should address overlapping needs and reduce costly repetitive maintenance. In addition, they should provide a measurable benefit (risk, LCCA, performance system, etc.)

Strategic solutions were derived from previous reports, field reviews, ADOT staff input, observable trends in the performance data, current standards, national and local best practices, and engineering judgement. **Table 2** contains the candidate strategic solutions for the corridor. **Appendix A** contains a Candidate Solution Cost Estimates table showing the derivation of total cost for each candidate solution.

Following the distribution of Draft Working Paper 5 (Strategic Solutions), candidate solutions were reviewed based on location, solution characteristics, and length. The following considerations were also made:

- Solutions that affect a specific subset of crashes (e.g. lighting, wildlife crossing or fencing) should be separated from other solutions and considered by themselves.
- Solutions that have an elevated crash modification factor (e.g. <0.50) should be separated from other solutions and considered by themselves (e.g. mainline realignment, parallel entry/exit ramps).
- Solutions should be packaged together by location/geography to the extent possible.

This analysis may have resulted in the combination or modification of the solutions presented in Working Paper 5.

Table 2: Candidate Solutions

Candidate #	Location #	Beginning Milepost	Ending Milepost	Name	Option*	Scope	Notes	Investment Category (Preservation [P], Modernization [M], Expansion [E])
CS95.1	L1/L2	29	34	Yuma Area Safety Improvements	-	Install two-way center turn lane (MP 29 – 32 expands from a 4-lane undivided highway to a 5-lane undivided highway, MP 32 – 34 expands from a 2-lane undivided highway to a 5-lane undivided highway); install raised medians at signalized intersection approaches (approximately 250' on each approach); improve signal visibility and install warning signs at the following intersections: Araby Road (MP 29.4), Avenue 7E (MP 29.9), Avenue 8E (MP 30.9), Avenue 11E (MP 33.7)	-	M/E
CS95.2	L4/L5	35	39	Fortuna Wash Area Safety Improvements	-	Install two-way center turn lane (expand from a 2-lane undivided highway to a 5-lane highway); widen bridge over canal (MP 38.0)		M
CS95.3	L4	39	42	Dome Valley Area Safety Improvements	-	Widen shoulders; install chevrons at horizontal curve from MP 40.1 to 40.4; install warning signs for intersections with Adair Park Rd (MP 39.7) and County 3rd St (MP 40.5)	Other improvements: Install "Heavy Roadside Activity" and "Slow Moving Vehicles" warning signs north of MP 40 and south of MP 34; Install wildlife fencing from MP 40 to 43, construct wildlife crossing at MP 40.2 to replace existing drainage structure and connect to wildlife fencing, install flashing wildlife warning system at MP 40-42.	M
CS95.4	L10/L11/ L12	59	80	Yuma Proving Ground Area Safety and Freight Improvements	A	Widen shoulders		M
					B	Construct alternating passing lanes		M
CS95.5	L11	59	71	Yuma Proving Ground Freight Improvements	-	Construct drainage structures and re-profile roadway at 10 locations where flows are concentrated by upstream channelization (MP 59 – MP 60 three crossings, MP 61.0, MP 62.4, MP 66.0, MP 66.8, MP 69.1-69.3 two crossings, MP 71.3)		
CS95.6	L15	111	131	Quartzsite to Bouse Wash Freight Improvements	-	Widen shoulders; Construct drainage structures and re-profile roadway at 19 locations with flooding potential: MP 110.8, 112.8, 113.1, 114.9, 115.1, 116.2, 116.6 are higher priority with upstream channelization concentrating flows; MP 117.1, 117.7, 118.9, 119.6, 119.8, 120.1, 120.6, 120.8, 121.4, 122.1, 122.3, 122.6 are additional locations		M
CS95.7	L16	116	121	Pavement Improvements	A	Rehabilitate pavement	During future project scoping, consider extending project to MP 132 (based on field review and District input)	P
					B	Replace pavement		M
CS95.8	L18	131	131	Bouse Wash Bridge Improvements	A	Rehabilitate bridge		P
					B	Replace bridge		M

Candidate #	Location #	Beginning Milepost	Ending Milepost	Name	Option *	Scope	Notes	Investment Category (Preservation [P], Modernization [M], Expansion [E])
CS95.9	L19	131	142	Bouse Wash to Parker Freight Improvements	A	Widen shoulders; construct drainage structure and re-profile roadway at MP 134.4		M
					B	Construct alternating passing lanes; construct drainage structure and re-profile roadway at MP 134.4		M
CS95.10	L20/L21	142	150	Parker Safety and Freight Improvements	-	Construct right turn lanes at Riverside Drive (MP 148.3, NB and SB), Cove Avenue (MP 148.2, NB and SB), Ironwood Road (MP 147.5, SB), and Mesquite Drive (MP 147.3, SB); Improve signal visibility and install warning signs and transverse rumble strips north of Resort Drive to alert southbound traffic		M
CS95.11	L22	148	149	Parker Pavement Improvements	A	Rehabilitate pavement		P
					B	Replace pavement		M
CS95.12	L23/L24	162	176	Bill Williams River Bridge to Lake Havasu City Safety and Freight Improvements	-	Widen shoulders in both the northbound and southbound direction; construct alternating passing lanes at MP 172.8 – MP 177 and MP 164 – MP 169.8; install curve warning signs, advisory speed sign and chevrons at MP 162.3	Other improvements: Install "Heavy Roadside Activity" warning signs.	M
CS95.13	L25/L26/ L28	177	190	Lake Havasu City Safety and Freight Improvements	A	Reconstruct 9 signalized intersections as double lane roundabouts (Mulberry Ave, Smoketree Ave, Swanson Ave, Mesquite Ave, Palo Verde Blvd S, Industrial Blvd, W Acoma Blvd, Kiowa Blvd N, Palo Verde Blvd N); install raised median throughout City limits (MP 177 – MP 186); mitigate differential settling on Falls Spring Wash Bridge (MP 186.2)		M
					B	Construct southbound right turn lanes at Smoketree Ave, Swanson Ave, W Acoma Blvd, Lake Dr; install raised median throughout City limits (MP 177 – MP 186); implement signal coordination/adjust timing; mitigate differential settling on Falls Spring Wash Bridge (MP 186.2)		M
CS95.14	L27	178	178	Mockingbird Wash Bridge Improvements	A	Rehabilitate bridge		P
					B	Replace bridge		M
CS95.15	L29	181	186	Lake Havasu City Pavement Improvements	A	Rehabilitate pavement		P
					B	Replace pavement		M
CS95.16	L32	194	198	Lake Havasu City to I-40 Freight Improvements	A	Widen shoulders MP 194.5 – MP 196.0		M
					B	Construct alternating passing lanes MP 196 – MP 198		M
CS95.17	L32	201.3	202	I-40 Approach Freight Improvements	-	Construct auxiliary lanes to create a 5-lane section through activity center; install signs prohibiting left turns in/out of the northern Wendy's/Pilot driveway	An interchange improvement study is recommended for the I-40/SR95 Interchange area.	E

*'-' indicates only one solution is being proposed and no options are being considered

3.1 Life-Cycle Cost Analysis

A LCCA was conducted for any bridge or pavement candidate solutions that contain multiple options. The intent of the LCCA was to determine which options warrant further investigation and eliminate options that would not be considered strategic.

Life-Cycle Cost Analysis is an economic analysis that compares cost streams over time and presents the results in a common measure, the present value of all future costs. The cost stream occurs over an analysis period that is long enough to provide a reasonably fair comparison among alternatives that may differ significantly in scale of improvement actions over shorter time periods. For both bridge and pavement LCCA, the costs are focused on agency (ADOT) costs for corrective actions to meet the objective of keeping the bridge or pavement serviceable over a long period of time.

LCCA is performed to provide a more complete holistic perspective on asset performance and agency costs over the life of an investment stream. This approach helps ADOT look beyond initial and short-term costs that often dominate the considerations in transportation investment decision-making and programming.

<u>Bridge</u>

For the bridge LCCA, three basic strategies were analyzed that differ in timing and scale of improvement actions to maintain the selected bridges, as described below:

- Bridge replacement (large upfront cost but small ongoing costs afterwards)
- Bridge rehabilitation until replacement (moderate upfront costs then small to moderate ongoing costs until replacement)
- On-going repairs until replacement (low upfront and ongoing costs until replacement)

The bridge LCCA model developed for the Corridor Profile Studies reviews the characteristics of the candidate bridges including bridge ratings and deterioration rates to develop the three improvement strategies (full replacement, rehabilitation until replacement, and repair until replacement). Each strategy consists of a set of corrective actions that contribute to keeping the bridge serviceable over the analysis period. Cost and effect of these improvement actions on the bridge condition are essential parts of the model. Other considerations in the model include bridge age, elevation, pier height, length-to-span ratio, skew angle, and substandard characteristics such as shoulders and vehicle clearance. The following assumptions are included in the bridge LCCA model:

- The bridge LCCA will only address the structural condition of the bridge and will not address other issues or costs
- The bridge will require replacement near the end of the its 75-year service life regardless of current condition
- The bridge elevation, pier height, skew angle, and length-to-span ratio can affect the replacement and rehabilitation costs
- The current and historical ratings were used to estimate a rate of deterioration for each candidate bridge
- Following bridge replacement, repairs will be needed every 20 years
- Different bridge repair and rehabilitation strategies have different costs, expected service life, and benefit to the bridge rating
- The net present value of future costs will be discounted at 3%
- If the LCCA evaluation recommends rehabilitation or repair, the project will not be considered strategic and the rehabilitation or repair will be addressed by normal programming processes
- Because this LCCA is conducted at a planning level, and due to the variabilities in costs and improvement strategies, the LCCA net present value results that are within 15% of each other should be considered equally. In such a case, the project should be carried forward as a strategic replacement project – more detailed scooping will confirm if replacement or rehabilitation is needed

Based on the candidate solutions presented in **Table 2**, LCCA was conducted on two bridges on the SR 95 corridor. A summary of this analysis is shown in **Table 3.** Additional information regarding the bridge LCCA is contained in **Appendix B**.

<u>Pavement</u>

For the pavement LCCA, three basic strategies are analyzed that differ in timing and scale of improvement actions to maintain the selected pavement, as described below:

- Pavement replacement (large upfront cost but small ongoing costs afterwards)
- Pavement major rehabilitation until replacement (moderate upfront costs then small to moderate ongoing costs until replacement)
- Pavement minor rehabilitation until replacement (low upfront and ongoing costs until replacement)

The pavement LCCA model developed for the Corridor Profile Studies reviews the characteristics of the candidate paving locations including the historical rehabilitation frequency to develop potential improvement strategies (full replacement, major rehabilitation until replacement, and minor rehabilitation until replacement, for either concrete or asphalt, as applicable). Each strategy consists of a set of corrective actions that contribute to keeping the pavement serviceable over the analysis period. Cost and effect of these improvement actions on the pavement condition are essential parts of the model. The following assumptions are included in the pavement LCCA model:

- The pavement LCCA will only address the condition of the pavement and will not address other issues or costs
- The historical pavement rehabilitation frequencies at each location were used to estimate the future rehabilitation frequencies
- Different pavement replacement and rehabilitation strategies have different costs and expected service life
- The net present value of future costs will be discounted at 3%
- If the LCCA evaluation recommends major or minor rehabilitation, the project will not be considered strategic and the rehabilitation will be addressed by normal programming processes

- Because this LCCA is conducted at a planning level, and due to variabilities in costs and improvement strategies, the LCCA net present value results that are within 15% of each other should be considered equally. In such a case, the project should be carried forward as a strategic replacement project - more detailed scoping will confirm if replacement or rehabilitation is needed.

Based on the candidate solutions presented in **Table 2**, LCCA was conducted for three pavement projects on the SR 95 corridor. A summary of this analysis is shown in **Table 4.** Additional information regarding the pavement LCCA is contained in **Appendix B.**

As shown in **Table 3** and **Table 4**, the following conclusions were determined based on the LCCA:

- Rehabilitation or repair was determined to be the most effective approach for the candidate solutions listed below and these locations do not have other Needs. Therefore, it is assumed that these will be addressed by normal programming processes and these candidate solutions will be dropped from further consideration:
    - Bouse Wash Bridge #1321 (CS95.8, MP 131.3)
    - Mockingbird Wash Bridge (CS95.14, MP 178)
    - Pavement Improvements (CS95.7, MP 116-121)
    - Parker Pavement Improvements (CS95.11, MP 148-149)
    - Lake Havasu City Pavement Improvements (CS95.15, MP 181-186)

Table 3: Bridge LCCA Results

Candidate Solution	Present Value at 3% Discount Rate ($)			Ratios of Present Value Compared to Lowest Present Value			Other Needs	Results
	Replace	Rehab	Repair	Replace	Rehab	Repair		
Bouse Wash Bridge #1321 (CS95.8, MP 131.3)	$7,562,929	**$5,692,468**	$5,987,017	1.33	1.00	1.05	-	Not strategic solution alone - Rehabilitation is recommended
Mockingbird Wash Bridge (CS95.14, MP 178)	$3,496,779	$3,188,062	**$2,154,715**	1.62	1.48	1.00	-	Not strategic solution alone - Repair is recommended

Table 4: Pavement LCCA Results

Candidate Solution	Present Value at 3% Discount Rate ($)				Ratios of Present Value Compared to Lowest Present Value				Other Needs	Results
	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehabilitation	Asphalt Light Rehabilitation	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehabilitation	Asphalt Light Rehabilitation		
Pavement Improvements (CS95.7, MP 116-121)	$18,516,655	$16,952,400	**$13,277,916**	$14,809,295	1.39	1.28	1.00	1.12	-	Reconstruction is not within 15% of lowest cost - Rehabilitation is recommended
Parker Pavement Improvements (CS95.11, MP 148-149)	$8,332,495	$7,628,580	**$5,975,062**	$6,664,183	1.39	1.28	1.00	1.12	-	Reconstruction is not within 15% of lowest cost - Rehabilitation is recommended
Lake Havasu City Pavement Improvements (CS95.15, MP 181-186)	$34,718,729	$31,785,751	**$24,896,093**	$27,767,428	1.39	1.28	1.00	1.12	-	Reconstruction is not within 15% of lowest cost - Rehabilitation is recommended

3.2 Performance Effectiveness Evaluation

After the LCCA process was complete, all remaining candidate solutions were evaluated based on their performance effectiveness. This process included determining a performance effectiveness score based on how much each solution impacts the existing Performance and level of Need scores for each solution segment. The results of this evaluation will be combined with the results of a risk analysis to determine a Performance Effectiveness Score. The objectives of the Performance Effectiveness Evaluation include:

- Measure of benefit in performance system versus cost of solution
- Include risk factors to help differentiate between similar solutions
- Applicable to each Performance Area that is affected by the candidate solution
- Accounts for Emphasis Areas that were identified for the corridor

The Performance Effectiveness Evaluation includes the following steps:

- Estimate the post-solution performance for each of the five performance areas (Pavement, Bridge, Mobility, Safety, and Freight)
- Use the post-solution performance scores to calculate a post-project level of Need for each of the five performance areas
- Compare the pre-solution level of Need to the post-project level of Need to determine the reduction in level of Need (potential project benefit) for each of the five performance areas
- Calculate performance area risk weighting factors for each of the five performance areas
- Using the reduction in level of Need (benefit) and risk weighting factors, calculate the Performance Effectiveness Score

For each Performance Area, a slightly different approach was used to estimate the post-solution performance. This process was based on the following assumptions:

- Pavement:
    - The International Roughness Index (IRI) rating would decrease (to 30 for replacement or 45 for rehabilitation)
    - The Cracking rating would decrease (to 0 for replacement or rehabilitation)
- Bridge:
    - The structural ratings would increase (+1 for repair, +2 for rehabilitation, or increase to 8 for replacement)
    - The bridge sufficiency rating would increase (+10 for repair, +20 for rehabilitation, or increase to 98 for replacement)
- Mobility:
    - Additional lanes would increase the capacity and therefore revise the Mobility Index and associated secondary measures
    - Other improvements (ramp metering, parallel ramps, variable speed limits, etc.) will also increase the capacity (to a lesser extent than additional lanes) and therefore revise the Mobility Index and associated secondary measures
    - Changes in the Mobility Index (due to increased capacity) would have a direct effect on the Travel Time Index (TTI) secondary measure
    - Changes in the Mobility Index (due to increased capacity) and Safety Index (due to crash reductions) would have a direct effect on the Planning Time Index (PTI) secondary measure
    - Changes in the Safety Index (due to crash reductions) would have direct effect on the Closure Extent secondary measure
- Safety:
    - Crash Modification Factors were developed and applied to estimate the reduction in crashes (see **Appendix C**)
- Freight:
    - Changes in the Mobility Index (due to increased capacity) and Safety Index (due to crash reductions) would have a direct effect on the Freight Index and the Truck PTI (TPTI) secondary measure
    - Changes in the Mobility Index (due to increased capacity) would have a direct effect on the Truck TTI (TTTI) secondary measure
    - Changes in the Safety Index (due to crash reductions) would have direct effect on the Closure Duration secondary measure

The Performance Area Risk Assessment is intended to develop a numeric risk weighting factor for each of the five Performance Areas. This risk assessment addresses other considerations for each Performance Area that are not directly included in the Performance System. A risk weighting factor is calculated for each candidate solution based on the specific characteristics at the solution location. For example, the Pavement Risk Factor is based on factors such as the elevation, daily traffic volumes, and amount of truck traffic. Additional information regarding the Performance Area Risk Assessment is included in **Appendix D**.

Following the calculation of the reduction in level of need (benefit) and the Performance Area Risk Factors, these values were used to calculate the PES. In addition, the reduction in level of need in each Emphasis Area was also included in the PES.

The benefit (reduction in need) was measured as a one-time benefit. However, different types of solutions will have varying service lives during which the benefits will be obtained. For example, a preservation solution would likely have shorter stream of benefits over time when compared to a modernization or expansion solution. To address the varying lengths of benefit streams, each solution was classified as a 10-year, 20-year, 30-year, or 75-year benefit stream (the F_{NPV} factor). A 3% discount rate was used to calculate F_{NPV} for each classification of solution. The service lives and respective factors are described below:

- A 10-year service life is generally reflective of a preservation solution. This would include pavement and bridge preservation solutions which would likely have a 10-year stream of benefits. For these solutions, a F_{NPV} of 8.8 was used in the PES calculation.
- A 20-year service life is reflective of modernization solutions that generally do not include new infrastructure. These solutions would likely have a 20-year stream of benefits. For these solutions, a F_{NPV} of 15.3 was used in the PES calculation
- A 30-year service life is generally reflective of an expansion solution or a modernization solution that includes new infrastructure. These solutions would likely have a 30-year stream of benefits. For these solutions, a F_{NPV} of 20.2 was used in the PES calculation

- A 75-year service life was used for bridge replacement solutions. For these solutions, a F_{NPV} of 30.6 was used in the PES calculation

Each solution also had varying degrees of exposure depending on the length of the solution and the daily traffic volume. The vehicle-miles travelled (VMT) at each solution provided a measure of the amount of traffic that would receive the benefit of the proposed solution. The following equation was used to calculate a factor (between 0 and 5) which was used in the calculation of the PES.

$$F_{VMT} = 5 - (5 \times e^{VMT \times -0.0000139})$$

The PES can be described as follows:

PES = (Sum of all Risk Factored Benefit Scores + Sum of all Risk Factored Emphasis Area Scores) / Cost x F_{VMT} x F_{NPV}

Where,

Risk Factored Benefit Score = Reduction in Segment-Level Need (benefit) x Performance Area Risk Weighting Factor (calculated for each performance area)

Risk Factored Emphasis Area Score = Reduction in Corridor-Level Need x Performance Area Risk Factors x Emphasis Area Factor (calculated for each emphasis area)

Cost = estimated cost of candidate solution in $ millions (see Appendix A)

F_{VMT} = factor between 0 and 5 to account for vehicle miles traveled at location of candidate solution based on current (2014) daily volume and length of solution

F_{NPV} = factor ranging from 8.8 to 30.6 (see above) to address anticipated longevity of service life (and duration of benefits) for each candidate solution

The resulting PES values are shown in **Table 5**. Additional information regarding the calculation of the PES is contained in **Appendix E**.

Following the LCCA, some options were eliminated from further consideration, including:

- Bouse Wash Bridge #1321 (CS95.8, MP 131.3)
- Mockingbird Wash Bridge (CS95.14, MP 178)
- Pavement Improvements (CS95.7, MP 116-121)
- Parker Pavement Improvements (CS95.11, MP 148-149)
- Lake Havasu City Pavement Improvements (CS95.15, MP 181-186)

However, in some cases, candidate solutions still contained multiple options. In these cases, the Performance Effectiveness Scores were calculated for each option to help identify the best performing option. On SR 95, this occurred at four locations:

- CS95.4 (A and B) - Yuma Proving Ground Area Safety and Freight Improvements
- CS95.9 (A and B) - Bouse Wash to Parker Freight Improvements
- CS95.13 (A and B) - Lake Havasu City Safety and Freight Improvements
- CS95.16 (A and B) - Lake Havasu City to I-40 Freight Improvements

Table 5: Performance Effectiveness Scores

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ million)	Risk Factored Benefit Score					Risk Factored Emphasis Area Scores			Total Factored Benefit Score	F_{VMT}	F_{NPV}	Performance Effectiveness Score
				Pavement	Bridge	Safety	Mobility	Freight	Safety	Mobility	Freight				
CS95.1	Yuma Area Safety	29-34	15.41	-	-	9.43	0.79	0.50	0.89	-	-	11.63	2.41	20.2	36.8
CS95.2	Fortuna Wash Area Safety Improvements	35-39	17.24	-	-	2.04	7.48	6.52	0.44	0.17	0.06	16.71	1.76	20.2	34.4
CS95.3	Dome Valley Area Safety	39-42	3.46	-	-	2.04	3.25	0.47	0.44	-	0.02	6.21	1.39	15.3	38.1
CS95.4A	Yuma Proving Ground Area Safety and Freight	59-80	31.00	-	-	7.33	8.86	5.73	2.51	0.03	0.02	24.47	1.82	15.3	22.0
CS95.4B	Yuma Proving Ground Area Safety and Freight	59-80	79.61	-	-	7.36	5.95	7.93	5.74	0.05	0.03	27.06	1.82	20.2	12.5
CS95.5	Yuma Proving Ground Freight Improvements	59-71	10.74	-	-	1.10	3.08	9.30	0.64	-	0.03	14.15	0.20	20.2	5.3
CS95.6	Quartzsite to Bouse Wash Freight	111-123	52.44	-	-	-	4.76	14.04	-	0.02	0.17	19.00	2.55	20.2	18.6
CS95.9A	Bouse Wash to Parker Freight	131-142	15.13	-	-	0.07	6.93	2.21	0.14	0.03	0.04	9.42	2.51	20.2	31.5
CS95.9B	Bouse Wash to Parker Freight	131-142	43.07	-	-	0.07	3.45	2.78	0.15	0.12	0.06	6.63	2.51	20.2	7.8
CS95.10	Parker Safety and Freight	142-150	2.65	-	-	5.98	0.52	0.62	0.68	-	-	7.81	0.33	15.3	15.1
CS95.12	Bill Williams River Bridge to Lake Havasu City Safety and Freight	164-177	56.31	-	-	7.83	8.73	7.77	6.49	0.04	0.09	30.95	3.45	20.2	38.3
CS95.13A	Lake Havasu City Safety and Freight	177-186	50.91	-	-	9.41	1.95	3.21	3.78	0.03	0.03	18.41	4.17	20.2	30.5
CS95.13B	Lake Havasu City Safety and Freight	177-186	16.99	-	-	5.39	1.37	0.37	2.21	0.03	0.01	9.36	4.17	15.3	35.2
CS95.16A	Lake Havasu City to I-40 Freight	194.5-196	2.26	-	-	0.60	2.20	0.21	0.06	-	-	3.07	0.76	15.3	15.8
CS95.16B	Lake Havasu City to I-40 Freight	196-198	7.56	-	-	4.12	4.45	2.30	0.57	0.02	0.01	11.47	0.99	20.2	30.3
CS95.17	I-40 Approach Freight	201.3-202	3.25			0.17	1.23	0.66	0.02	0.02	-	2.10	0.37	20.2	4.8

4.0 CANDIDATE SOLUTION PRIORITIZATION

Following the calculation of the PES, an additional step was taken to develop the prioritized list of solutions. A risk probability and consequence analysis was conducted to develop a project-level risk weighting factor. This risk analysis is a numeric scoring system to help address the risk of not implementing a solution based on the likelihood and severity of the performance failure. **Figure 4** shows the risk matrix that was used to develop the risk weighting factors.

Figure 4: Risk Matrix

		Severity/Consequence				
		Insignificant	Minor	Significant	Major	Catastrophic
Frequency/ Likelihood	Very Rare	Low	Low	Low	Moderate	Major
	Rare	Low	Low	Moderate	Major	Major
	Seldom	Low	Moderate	Moderate	Major	Severe
	Common	Moderate	Moderate	Major	Severe	Severe
	Frequent	Moderate	Major	Severe	Severe	Severe

Using the risk matrix in **Figure 4**, numeric values were assigned to each category of frequency and severity. The higher the risk, the higher the numeric factor that was assigned. The risk weight for each area of the matrix was calculated by multiplying the severity factor times the frequency factor. These numeric factors are shown in **Figure 5**.

Figure 5: Numeric Risk Matrix

			Severity/Consequence				
			Insignificant	Minor	Significant	Major	Catastrophic
		Weight	1.00	1.10	1.20	1.30	1.40
Frequency/ Likelihood	Very Rare	1.00	1.00	1.10	1.20	1.30	1.40
	Rare	1.10	1.10	1.21	1.32	1.43	1.54
	Seldom	1.20	1.20	1.32	1.44	1.56	1.68
	Common	1.30	1.30	1.43	1.56	1.69	1.82
	Frequent	1.40	1.40	1.54	1.68	1.82	1.96

Using the values in **Figure 5**, risk weighting factors were calculated for each of the following four risk categories: low, moderate, major, and severe. These values are simply the average of the values in **Figure 5** that fall within each category. The resulting average risk weighting factors are:

Low	Moderate	Major	Severe
1.14	1.36	1.51	1.78

The risk weighting factors listed above were assigned to the five performance areas as follows:

- Safety = 1.78
  - The Safety performance area quantifies the likelihood of fatal or incapacitating crashes; therefore, it was assigned the Severe (1.78) risk weighting factor.
- Bridge = 1.51
  - The Bridge performance area focuses on the structural adequacy of the bridges. A failure may result in crashes or traffic being detoured for long periods of time resulting in significant travel time increases; therefore, it was assigned the Major (1.51) risk weighting factor.
- Mobility and Freight = 1.36
  - The Mobility and Freight performance areas focus on capacity and congestion. Failure in either of these performance areas would result in increased travel times but would not have significant effect on safety (crashes) that would not already be addressed in the Safety performance area; therefore, they were assigned the Moderate (1.36) risk weighing factor.
- Pavement = 1.14
  - The Pavement performance area focuses on the ride quality of the pavement. Failure in this performance area would likely be a spot location that would not dramatically affect drivers beyond what is already captured in the Safety performance area.

The benefit in each performance area was calculated for each candidate solution as part of the Performance Effectiveness Evaluation. Using this information, and the risk factors listed above, a weighted (based on benefit) solution-level numeric risk factor was calculated for each candidate solution. For example, a solution that has 50% of its benefit in Safety and 50% of its benefit in Mobility would have a risk factor of 1.57 (0.50 x 1.36 + 0.50 x 1.78 = 1.57). These risk factors were applied in the calculation of the Prioritization Score (PS) which can be described as follows:

*PS = PES x Risk Factor x Segment Need (see **Appendix E** for additional information)*

Where,

*PES = Performance Effectiveness Score (see **Table 5**)*

Risk Factor = Factor to address risk of not implementing a solution based on the likelihood and severity of the performance failure

Segment Need = Average segment need score (Working Paper 4)

Table 6 lists the strategic solutions recommended as a result of this corridor profile study. Solutions are listed in order of their prioritization score. These solutions will increase the performance of the SR 95 corridor across a majority of the performance areas. Solutions that address multiple performance areas tend to score higher in this process. Several projects on the corridor scored high on the Performance Effectiveness Scale due to overlapping benefits in different performance areas.

Table 6: Prioritized Recommended Solutions List

Rank	Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ million)	Performance Effectiveness Score	Weighted Risk Factor	Segment Need	Prioritization Score	Solution Need Reduction Notes
1	CS95.13B	Lake Havasu City Safety and Freight Improvements (Turn Lanes and Median)	177-186	17.0	35.2	1.70	1.85	110	Reduces the Safety need by 23% and the Mobility and Freight need by 13% and 4%
2	CS95.3	Dome Valley Area Safety Improvements	39-42	3.5	38.1	1.53	1.62	94	Reduces the Safety need by 26% and the Mobility and Freight need by 23% and 2%
3	CS95.13A	Lake Havasu City Safety and Freight Improvements (Roundabouts and Median)	177-186	50.9	30.5	1.66	1.85	93	Reduces the Safety need by 41% and the Mobility and Freight need by 19% and 35%
4	CS95.12	Bill Williams River Bridge to Lake Havasu City Safety and Freight Improvements	164-177	56.3	38.3	1.55	1.38	83	Reduces the Safety need by 50% and the Mobility and Freight need by 67% and 34%
5	CS95.2	Fortuna Wash Area Safety Improvements	35-39	17.2	34.4	1.42	1.62	79	Reduces the Safety need by 26% and the Mobility and Freight need by 53% and 27%
6	CS95.9A	Bouse Wash to Parker Freight Improvements (Shoulder Widening)	131-142	15.1	31.5	1.37	1.62	70	Reduces the Safety need by 36% and the Mobility and Freight need by 48% and 7%
7	CS95.1	Yuma Area Safety Improvements	29-34	15.4	36.8	1.73	0.92	59	Reduces the Safety need by 79% and the Mobility and Freight need by 18% and 16%
8	CS95.4A	Yuma Proving Ground Area Safety and Freight Improvements (Shoulder Widening)	59-80	31.0	22.0	1.53	1.62	54	Reduces the Safety need by 81% and the Mobility and Freight need by 26% and 6%
9	CS95.16B	Lake Havasu City to I-40 Freight Improvements (Passing Lanes)	196-198	7.6	30.3	1.53	1.15	54	Reduces the Safety need by 66% and the Mobility and Freight need by 7% and 3%
10	CS95.10	Parker Safety and Freight Improvements	142-150	2.7	15.1	1.72	1.54	40	Reduces the Safety need by 61% and the Mobility and Freight need by 9% and 5%
11	CS95.4B	Yuma Proving Ground Area Safety and Freight Improvements (Passing Lanes)	59-80	79.6	12.5	1.56	1.62	32	Reduces the Safety need by 81% and the Mobility and Freight need by 17% and 8%
12	CS95.16A	Lake Havasu City to I-40 Freight Improvements (Shoulder Widening)	194.5-196	2.3	15.8	1.45	1.15	26	Reduces the Safety need by 9% and the Mobility need by 3%
13	CS95.6	Quartzsite to Bouse Wash Freight Improvements	111-123	52.4	18.6	1.36	0.92	23	Reduces the Mobility and Freight need by 50% and 76%
14	CS95.9B	Bouse Wash to Parker Freight Improvements (Passing Lanes)	131-142	43.1	7.8	1.37	1.62	17	Reduces the Safety need by 37% and the Mobility and Freight need by 24% and 9%
15	CS95.5	Yuma Proving Ground Freight Improvements	59-71	10.7	5.3	1.41	1.62	12	Reduces the Safety need by 12% and the Mobility and Freight need by 10% and 9%
16	CS95.17	I-40 Approach Freight Improvements	201.3-202	3.3	4.8	1.40	1.15	8	Reduces the Safety need by 3% and the Mobility and Freight need by 2% and 1%

5.0 NEXT STEPS

The strategic investments recommended in this study are not intended to be a substitute or replacement for traditional ADOT project development processes where various ADOT technical groups and districts develop candidate projects for consideration in the performance based programming in the P2P Link process. Rather, these strategic investments are intended to complement ADOT's project development processes with non-traditional solutions to address performance needs in one or a combination of the five performance areas of Pavement, Bridge, Mobility, Safety, and Freight. Strategic investments developed for the SR 95 corridor will be considered along with other candidate projects in the ADOT statewide programming process.

The concluding step in the corridor profile studies will be to produce a final report for the Round 2 studies (I-40E, I-8, and SR95) that summarizes working papers 1 through 6. Additional final reports for Round 3 will be completed following the full development of those working papers.

Upon completion of all three rounds, the results will be incorporated into a summary document comparing all corridors and is expected to provide a performance-based review of statewide needs

APPENDIX A: CANDIDATE SOLUTION COST ESTIMATES

Candidate #	Location #	Name	Investment Category (Preservation [P], Modernization [M], Expansion [E])	Option	Scope	BMP	EMP	Unit	Quantity	Factored Construction Unit Cost	Preliminary Engineering Cost	Design Cost	Right-of-Way Cost (assuming $12/sf)	Construction Cost	Total Cost
CS95.1	L1/L2	Yuma Area Safety Improvements	M	-	Install Center Turn Lane (4-lane to 5-lane)	29	32	mi	2.62	$2,316,600	$180,000	$610,000	$0	$6,072,300	$6,862,300
					Install Center Turn Lane (2-lane to 5-lane)	32	34	mi	2.00	$3,467,200	$210,000	$690,000	$0	$6,934,400	$7,834,400
					Install Warning Signs at Signalized Intersections	-	-	each	4	$5,500	$0	$0	$0	$22,000	$22,000
					Install Raised Medians at Signalized Intersection Approaches	-	-	mi	0.38	$792,000	$10,000	$30,000	$0	$300,000	$340,000
					Improve Signal Visibility	-	-	each	4	$77,000	$10,000	$30,000	$0	$308,000	$348,000
					Solution Total						**$410,000**	**$1,360,000**	**$0**	**$13,636,700**	**$15,406,700**
CS95.2	L4/L5	Fortuna Wash Area Safety Improvements	M	-	Install Center Turn Lane (2-lane to 5-lane)	35	39	mi	4	$3,467,200	$400,000	$1,400,000	$0	$13,868,800	$15,668,800
					Widen Bridge over Existing Canal (Welton Mohawk Canal Bridge)	-	-	sf	3760	$390	$0	$100,000	$0	$1,466,400	$1,566,400
					Solution Total						**$400,000**	**$1,500,000**	**$0**	**$15,335,200**	**$17,235,200**
CS95.3	L4	Dome Valley Area Safety Improvements	M	-	Widen Shoulders	39	42	mi	3	$1,007,600	$100,000	$300,000	$0	$3,022,800	$3,422,800
					Install Chevrons	40.1	40.4	mi	0.3	$40,500	$0	$0	$0	$12,150	$12,150
					Install Intersection Warning Signs	-	-	each	4	$5,500	$0	$0	$0	$22,000	$22,000
					Solution Total						**$100,000**	**$300,000**	**$0**	**$3,056,950**	**$3,456,950**
CS95.4	L10/L11 / L12	Yuma Proving Ground Area Safety and Freight Improvements	M	A	Widen Shoulders	59	80	mi	21	$1,306,800	$820,000	$2,740,000	$0	$27,442,800	$31,002,800
					Option A: Solution Total						**$820,000**	**$2,740,000**	**$0**	**$27,442,800**	**$31,002,800**
				B	Construct Alternating Passing Lanes	59	80	mi	21	$3,300,000	$2,080,000	$6,930,000	$1,300,000	$69,300,000	$79,610,000
					Option B: Solution Total						**$2,080,000**	**$6,930,000**	**$1,300,000**	**$69,300,000**	**$79,610,000**
CS95.5	L11	Yuma Proving Ground Freight Improvements	M	-	Construct Drainage Structures - Intermediate	-	-	each	8	$1,188,000	$290,000	$950,000	$0	$9,504,000	$10,744,000
					Construct Drainage Structures - Minor	-	-	each	2	$616,000	$40,000	$120,000	$0	$1,232,000	$1,392,000
					Solution Total						**$290,000**	**$950,000**	**$0**	**$9,504,000**	**$10,744,000**
CS95.6	L15	Quartzsite to Bouse Wash Freight Improvements	M	-	Widen Shoulders	111	131	mi	20	$1,306,800	$780,000	$2,610,000	$0	$26,136,000	$29,526,000
					Construct Drainage Structures - Intermediate	-	-	each	15	$1,188,000	$530,000	$1,780,000	$0	$17,820,000	$20,130,000
					Construct Drainage Structures - Minor	-	-	each	4	$616,000	$70,000	$250,000	$0	$2,464,000	$2,784,000
					Solution Total						**$1,380,000**	**$4,640,000**	**$0**	**$46,420,000**	**$52,440,000**
CS95.9	L19	Bouse Wash to Parker Freight Improvements	M	A	Widen Shoulders	131	142	mile	11	$1,108,800	$370,000	$1,220,000	$0	$12,196,800	$13,786,800
					Construct Drainage Structures - Intermediate	-	-	each	1	$1,188,000	$40,000	$120,000	$0	$1,188,000	$1,348,000
					Option A: Solution Total						**$410,000**	**$1,340,000**	**$0**	**$13,384,800**	**$15,134,800**
			M	B	Construct Alternating Passing Lanes	131	142	mi	11	$3,300,000	$1,090,000	$3,630,000	$700,000	$36,300,000	$41,720,000
					Construct Drainage Structures - Intermediate	-	-	each	1	$1,188,000	$40,000	$120,000	$0	$1,188,000	$1,348,000

Candidate #	Location #	Name	Investment Category (Preservation [P], Modernization [M], Expansion [E])	Option	Scope	BMP	EMP	Unit	Quantity	Factored Construction Unit Cost	Preliminary Engineering Cost	Design Cost	Right-of-Way Cost (assuming $12/sf)	Construction Cost	Total Cost
					Option B: Solution Total						**$1,130,000**	**$3,750,000**	**$700,000**	**$37,488,000**	**$43,068,000**
CS95.10	L20/L21	Parker Safety and Freight Improvements	M	-	Construct Right-Turn Lanes	-	-	each	6	$374,000	$100,000	$200,000	$20,000	$2,244,000	$2,564,000
					Improve Signal Visibility	-	-	each	1	$77,000	$0	$0	$0	$77,000	$77,000
					Install Warning Signs	-	-	each	1	$5,500	$0	$0	$0	$5,500	$5,500
					Install Transverse Rumble Strips	-	-	each	1	$7,000	$0	$0	$0	$7,000	$7,000
					Solution Total						**$100,000**	**$200,000**	**$20,000**	**$2,333,500**	**$2,653,500**
CS95.12	L23/L24	Bill Williams River Bridge to Lake Havasu City Safety and Freight Improvements	M	-	Widen Shoulders	162	176	mi	14	$1,157,200	$500,000	$1,600,000	$0	$16,200,800	$18,300,800
					Construct Alternating Passing Lanes	172.8	177	mi	4.2	$3,300,000	$400,000	$1,400,000	$300,000	$13,860,000	$15,960,000
					Construct Alternating Passing Lanes	164	169.8	mi	5.8	$3,300,000	$600,000	$1,900,000	$400,000	$19,140,000	$22,040,000
					Install Chevrons	162.3	162.3	mi	0.25	$40,500	$0	$0	$0	$10,125	$10,125
					Solution Total						**$1,500,000**	**$4,900,000**	**$700,000**	**$49,210,925**	**$56,310,925**
CS95.13	L25/L26 /L28	Lake Havasu City Safety and Freight Improvements	M	A	Construct Double-Lane Roundabouts	-	-	each	9	$3,960,000	$1,100,000	$3,600,000	$0	$35,640,000	$40,340,000
					Install Raised Medians	177	186	mi	9	$792,000	$200,000	$700,000	$0	$7,128,000	$8,028,000
					Rehabilitate Bridge (Falls Springs Wash Bridge)	-	-	sf	16000	$140	$100,000	$200,000	$0	$2,240,000	$2,540,000
					Option A: Solution Total						**$1,400,000**	**$4,500,000**	**$0**	**$45,008,000**	**$50,908,000**
				B	Construct Turn Lanes	-	-	each	4	$374,000	$0	$100,000	$10,000	$1,496,000	$1,606,000
					Install Raised Medians	177	186	mi	9	$792,000	$200,000	$700,000	$0	$7,128,000	$8,028,000
					Implement Signal Coordination	176	190	mi	14	$308,000	$100,000	$400,000	$0	$4,312,000	$4,812,000
					Rehabilitate Bridge (Falls Springs Wash Bridge)	-	-	sf	16000	$140	$100,000	$200,000	$0	$2,240,000	$2,540,000
					Option B: Solution Total						**$400,000**	**$1,400,000**	**$10,000**	**$15,176,000**	**$16,986,000**
CS95.16	L32	Lake Havasu City to I-40 Freight Improvements	M	A	Widen Shoulders	194.5	196	mi	1.5	$1,306,800	$60,000	$200,000	$0	$2,000,000	$2,260,000
					Option A: Solution Total						**$60,000**	**$200,000**	**$0**	**$2,000,000**	**$2,260,000**
				B	Construct Alternating Passing Lanes	196	198	mi	2	$3,300,000	$200,000	$660,000	$100,000	$6,600,000	$7,560,000
					Option B: Solution Total						**$200,000**	**$660,000**	**$100,000**	**$6,600,000**	**$7,560,000**
CS95.17	L32	Lake Havasu City to I-40 Freight Improvements	M	-	Construct Auxiliary Lanes	201.3	202	mi	0.7	$2,011,000	$80,000	$280,000	$90,000	$2,800,000	$3,250,000
					Solution Total						**$80,000**	**$280,000**	**$90,000**	**$2,800,000**	**$3,250,000**

APPENDIX B: LIFE-CYCLE COST ANALYSIS

ADOT SR 95 BRIDGE LCCA

1.1 Introduction

This section presents the results of a Life Cycle Cost Analysis (LCCA) for selected bridges on SR 95. The LCCA is one method used to assess the potential for bridges to advance as strategic projects in the set of corridor recommendations, either on their own as a bridge-only strategic project, or combined with other needs on the roadway associated with the bridge. Full replacement is the main case of interest for a strategic bridge project.

The format of this section is as follows.

- how bridge improvements work now
- what is a life cycle cost analysis and why is it performed
- SR 95 bridges identified for LCCA (and why)
- the SR 95 corridor bridge profile LCCA model
- results of SR 95 LCCA and how used in the Corridor Profile Studies (CPS)
- next steps

1.2 How Bridges Are Cared For Now

ADOT's essential objective is to keep each bridge in working order (rating of 4 or higher) in an economical manner. Key considerations involved in achieving this objective include the traffic volumes and role of the roadway facility for which the bridge is a feature, the rate of deterioration of the bridge and its major components or subsystems, the user impact of restrictions or detours should the bridge not perform adequately, and the total funding available for bridge maintenance, repair, rehabilitation, and replacement over a time period. Bridges have a long design life (typically 75 years) so they are seldom completely replaced unless a larger improvement project on the associated roadway is required to add capacity or make other operational or safety improvements.

In a perfect world with adequate funding, ADOT's bridge managers would apply "optimal" or most cost-effective (i.e. economical) corrective actions to maintain a bridge's condition at 4 or higher out of 9. In the less than perfect real world with funding often in short supply, less expensive but sometimes less economical actions are applied to keep the bridges in service due to overall funding limitations. This approach tends to minimize ADOT costs in the short term but can contribute to increased costs in the longer term. If occasional short term funding limitations are followed by adequate funding levels, this adverse consequence can generally be remedied. But if funding limitations become the norm then the avoidable future cost increases can become a serious liability for the agency. The bridge LCCA has been proposed as part of this CPS in order to identify cases where spending more money sooner may provide a more economical strategy over time to keeping a bridge in working order. It also provides an opportunity to consider if other non-bridge needs on the associated roadway may be combined with bridge needs to develop a solution strategy that accomplishes multiple objectives with reduced interruption to the traveling public.

1.3 Life Cycle Cost Analysis – What and Why

Life Cycle Cost Analysis is an economic study that compares the cost stream over time of a set of improvement actions from different alternatives and presents the results in a common measure, the present value of all future costs. The alternatives are focused on achieving the same or very similar objectives from three different strategic approaches. These three strategies are Option 1 Replace immediately, Option 2 Rehabilitate immediately then replacement at 75 years old, and Option 3 Continue ongoing repairs until replacement at 75 years old. The cost stream occurs over an analysis period that is long enough to provide a reasonably fair comparison among alternatives that may differ significantly in scale of improvement actions over shorter time periods. For this bridge LCCA the costs are focused on agency (ADOT) costs for corrective actions to meet the objective of keeping a bridge serviceable over a long period of time. LCCA often also includes user costs (i.e. benefits) but those were omitted for this initial analysis except in a qualitative manner. The focus has remained on ADOT agency costs.

The reason for performing life cycle cost analysis is to provide a more complete holistic perspective on asset condition, performance, and agency costs over the life of an investment stream. This approach helps ADOT look beyond initial and short term costs which often dominate the considerations in transportation investment decision making and programming, especially under severe financial constraints.

In this bridge life cycle cost analysis, three basic strategies are analyzed that differ in timing and scale of improvement actions to maintain the selected bridges. These strategies are immediate bridge replacement (large up-front cost but small ongoing costs afterwards), immediate rehabilitation until replacement (moderate up-front costs then small to moderate ongoing costs until replacement), and ongoing repairs until replacement (low up front and ongoing costs until replacement).

1.4 Bridges Selected for SR 95 LCCA

Two bridges were selected for LCCA for SR 95. They were selected due to their current ratings and their historical ratings. The bridges selected for LCCA analysis are listed below along with the bridge number and the year ending their typical 75-year life.

a. Bouse Wash Bridge - #1321 (2045) – carries SR 95 over wash
b. Mockingbird Wash Bridge - #1915 (2057) – carries SR 95 over wash

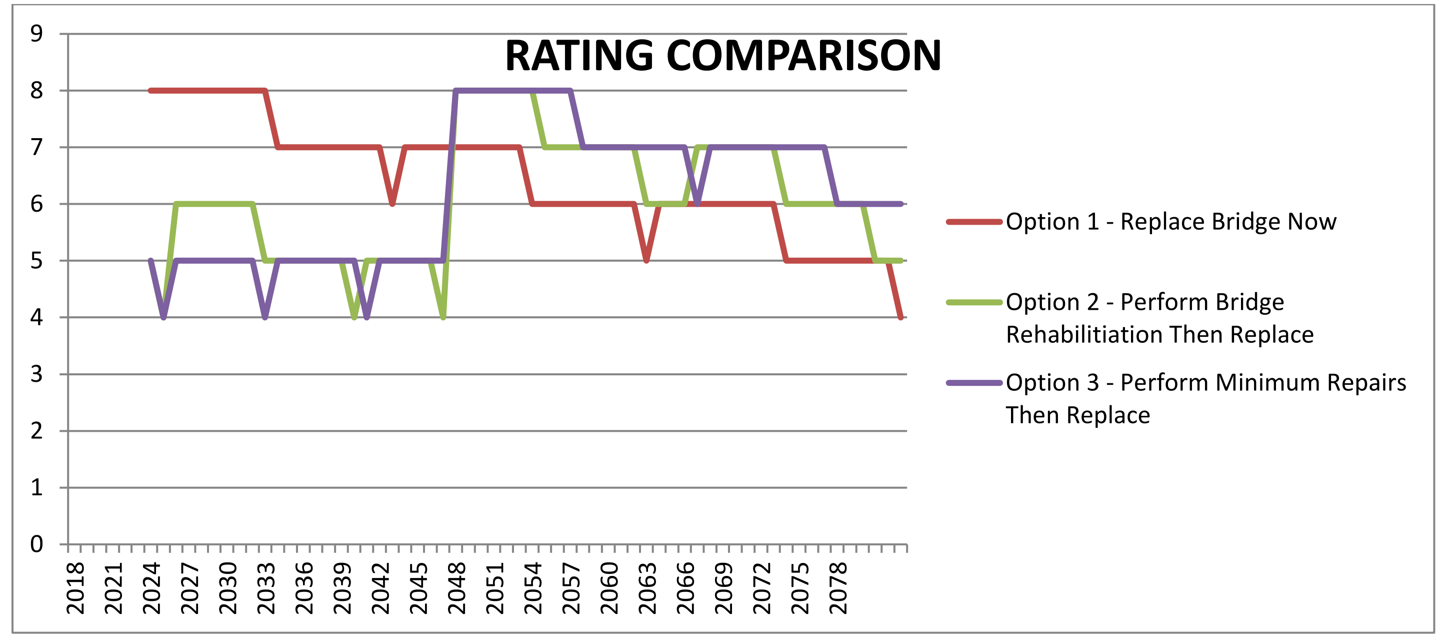
The two bridges above have their 75-year end of life occurring after 2040. It was decided after making the LCCA selections that bridges aging out before 2030 need replacement soon enough to be identified for a strategic bridge replacement without further LCCA efforts. They should be checked, however, for possible deck area increases during that replacement to meet current standards and to accommodate any mobility widenings (adding lanes) or lengthening (widen roadway underneath) that may be driven by other needs on the roadway segment.

1.5 The Corridor Profile Study Bridge LCCA Model Overview

The bridge LCCA model for the CPS reviews the characteristics of the selected bridges including bridge ratings and deterioration rates to develop three economic improvement strategies as outlined earlier – full replacement, rehabilitation until replacement, and repair until replacement. Each strategy consists of a set of corrective actions that contribute to keeping the bridge serviceable over the analysis period. Cost and effect of these improvement actions on the bridge condition are essential parts of the model. Other considerations in the model include bridge age, elevation, pier height, length to span ratio, skew angle, and substandard characteristics such as shoulders and vehicle clearance.

The effect on the bridge condition over time for each strategy is shown on **Figure 1** for illustration from one of the SR 95 bridges, the Bouse Wash bridge which carries the SR 95 mainline over that feature. That chart shows the bridge rating in each year over the analysis period by improvement strategy. Similar charts were generated for other SR 95 LCCA bridges.

Figure 1: Bridge Condition Rating for SR 95 Bouse Wash Bridge by Year by Improvement Strategy



Source: Kimley-Horn, 2016

This bridge hits the 75-year replacement limit in 2045. The three strategies have very close average rating over the analysis period – in the range of 6.10 to 6.45 – although they differ year to year.

The costs of the set of improvement actions in each strategy that resulted in the Bouse Wash bridge ratings chart above is shown in **Table 1**. Agency costs are shown in total $1,000s undiscounted and discounted (present value at 3%) 2015 $ over the 65-year analysis period ending in 2080.

Table 1: Cost of Future Improvement Strategies for Bouse Wash Bridge

Cost of Strategy: 2021-2080, 2015 $1,000		
OPTION	**Undiscounted**	**PV 3%**
Option 1 (Replace)	$9,581	$7,562
Option 2 (Rehab)	$11,690	$5,692
Option 3 (Repair)	$14,034	$5,987

Source: Kimley-Horn 2016

In this case the Option 1 full replacement immediately is the lowest cost in undiscounted dollars, but the Option 2 rehab strategy (followed by replacement when the bridge life hits 75 years) is the lowest cost in discounted dollars, which is a better metric to use. Similar calculations were completed for the other SR

95 LCCA bridges. In this case there would not be a strategic bridge project (full replacement) at least from a bridge-only perspective without regard to other needs on the associated roadway.

The next section of this chapter shows how the results are used in identifying candidate strategic bridge projects from the set of bridges selected for LCCA, first looking at the bridges alone, then afterwards looking at the bridges in the context of the other needs on its associated roadway.

1.6 Life Cycle Cost Results

This section reviews the life cycle cost results from several perspectives. These are:

- undiscounted total ADOT costs over the analysis period
- discounted total ADOT costs over the analysis period
- how close the various strategies are
- combining bridge LCCA results with other needs on the connecting roadway

1.6.1 ADOT Future Costs by Bridge Strategy - Undiscounted

Table 2 summarizes the bridge life cycle cost results for the two SR 95 bridges selected for this analysis for the three improvement strategies. The results are all in undiscounted 2015 dollars – i.e. no time value of money. The shading colors indicate the rank order of the costs with green as the lowest, yellow as second, and red as highest.

Table 2: Total Costs by Strategy by Bridge - Undiscounted 2015$

SR 95 Bridge			ADOT Future Costs: 2021-2080 2015 $1,000 Undiscounted		
Item	Name	Number	1-Replace	2-Rehab	3-Repair
1	Bouse Wash	1321	$9,581	$11,690	$14,034
2	Mockingbird Wash	1915	$4,436	$7,316	$5,989

Source: Kimley-Horn 2016

All two bridges in all improvement strategy cases kept the bridge rating above 4 in an economical manner in all years.

The total cost of mitigation strategies for these two bridges range from a low of $4.4 million to a high of $14.0 million over the analysis period. Full bridge replacement as soon as possible is the lowest cost strategy to keep all two bridges at rating of 4 or higher over the analysis period in an economical manner. Full replacement immediately introduces a major corrective action up front followed by minimal minor repair actions over the remaining years of the analysis period. The Option 3 minimum repair strategy (until required end of life replacement) is second lowest for Mockingbird Wash bridge and the highest for Bouse Wash bridge. Rehabilitation followed by replacement is the highest cost strategy for Mockingbird Wash bridge.

1.6.2 ADOT Future Costs by Bridge Strategy – Present Value Costs (at 3% discount rate)

The time value of money was not considered in the previous section but is actually a very important consideration. This section describes how discounting future investments affects the comparative results of the different bridge improvement strategies.

Table 3 shows the total cost for the same corrective actions as in Table 2 except that the future expenditures are discounted to present value costs at a 3% annual rate. As with Table 2 the color shading indicates the rank order of the strategies. The order for discounted results is different than for the undiscounted values.

Table 3: Total Costs by Strategy by Bridge - Discounted 2015$

SR 95 Bridge			ADOT Future Costs: 2021-2080 2015 $1,000 PV 3%		
Item	Name	Number	1-Replace	2-Rehab	3-Repair
1	Bouse Wash	1321	$7,562	$5,692	$5,987
2	Mockingbird Wash	1915	$3,496	$3,188	$2,154

Source: Kimley-Horn 2016

In this discounted perspective the Option 2 or Option 3 is the lowest cost strategy for Bouse Wash bridge and Mockingbird Wash bridge, respectively. Option 1 replace strategy is the highest cost for both bridges. Again the average bridge condition rating over the analysis period is similar in all three cases. These results reinforce the experience of ADOT Bridge Group staff that replacing a bridge is a very rare event unless a related mobility or other need creates a larger project within which a full bridge replacement is called for, something that will be examined later in this chapter.

1.6.3 Future Costs Present Value – Tolerance Band Around Lowest Cost Strategy

While the previous section looked at the LCCA present value results in pure rank order, this section examines “how close” the results and rankings are to see if there are differences among strategies that are small enough to be assumed a tie and thus possibly modify the interpretation of results. This test acknowledges the high degree of uncertainty in the life cycle cost analysis at the level of the corridor profile study.

A "tolerance" of 15% of the difference between strategies was established as a tie. This tolerance suggests that if the second lowest cost strategy is within 15% of the lowest cost and the second lowest cost is a more aggressive strategy than the lowest cost strategy, then the two strategies are essentially tied, and the designation for lowest cost goes to the more aggressive strategy.

Table 4 shows the same color ranking as the previous table for discounted total costs. For the second highest cost (yellow shading) and highest cost strategy (red shading), the percentage value shown is the percent that that strategy is above the next lower strategy (yellow to green, and red to yellow). If the value shown in yellow is 15% or less then it is tied with the green and the more aggressive strategy of the two is considered lowest cost. If the red value is 15% or less then the red strategy is considered a tie with the yellow strategy which may come into play in the "other needs" consideration presented later in this section. Finally, the fourth percentage column on the right is the percent that the highest cost strategy (red shading) is above the lowest cost strategy (green shading). If this percentage is less than or equal to 15% and the highest cost strategy is more aggressive than both the lowest or second cost strategy (i.e. full replacement), then the revised designation of lowest cost strategy goes to the most aggressive strategy – full replacement.

Table 4: Percent Cost Above Next Lower Cost Strategy

SR 95 Bridge			% Above Next Lower Value Present Value 3%			% High to Low
Item	Name	Number	1-Replace	2-Rehab	3-Repair	Red/Green
1	Bouse Wash	1321	26.3%	0.0%	5.2%	32.9%
2	Mockingbird Wash	1915	9.7%	48.0%	0.0%	62.3%

Source: Kimley-Horn 2016

For SR 95 the outright lowest discounted cost strategy was Option 2 rehab for one bridge – Bouse Wash bridge, so the tolerance band is not applicable as rehabilitation is already the most aggressive strategy. For Mockingbird Wash bridge, the lowest cost (green) was always Option 3 Repair. The second lowest cost strategy (yellow shading) was never within 15% of the lowest cost or green strategy. So the tolerance test does not affect the outcomes of this bridge. None of the two bridges are to be nominated for a strategic bridge replacement.

1.6.4 Other Considerations Combined with Life Cycle Cost Analysis

Other considerations in the reassessment of the LCCA results are focused on non-LCCA results that may still identify a bridge for replacement due to a mobility need for widening (or lengthening over another roadway being widened) to add a travel lane to increase roadway capacity. Other non-mobility needs that do not directly affect widening or lengthening may be considered as well. These include pavement, safety, and freight.

The Bouse Wash bridge had Option 2 Rehab as its lowest present value cost strategy. There is no mobility need that would widen this bridge to add capacity to SR 95. There is a freight need and a pavement need on SR 95. However, those specific needs do not associate with the bridge itself. Thus, there is still no strategic bridge replacement recommendation for this bridge and it defaults to the non-strategic rehabilitation until replacement.

The Mockingbird bridge had Option 3 Repair as its lowest present value cost strategy. There is no mobility need associated with this bridge that would widen it to add capacity to SR 95. There are pavement, safety, and freight needs associated with this segment of SR 95. However, those specific needs do not associate with the bridge itself. Thus, there is still no strategic bridge replacement recommendation for this bridge and it defaults to the non-strategic repair until replacement.

Table 5 summarizes the results of the two bridges that entered the LCCA. Both bridges default to the usual repair or rehabilitation unless a larger project comes along that includes the bridge replacement.

Table 5: Summary of SR 95 Bridge LCCA Results

Item	Bridge Name	Bridge #	75th Year	Carries	Over	LCCA Results	Reason for Replacement
1	Bouse Wash	1321	2045	SR 95	Wash	Rehab	N/A
2	Mockingbird Wash	1915	2057	SR 95	Wash	Repair	N/A

Source: Kimley-Horn 2016

Mockingbird Wash Bridge (#1915) / SR 95 / MP 178.26

Bridge Information	
Bridge Deck Area (A225)	11573 SF
Year Built (N27)	1982
Exp Service Life	75 YR
Total Bridge Length (N49)	163 LF
Number of Spans (N45+N46)	5
Skew Angle (N34)	13 DEG
Average Elevation	810 FT
Max Pier Height	18 FT
* Amount of Widening for Bridge	0 FT
Revised Deck Area (Bridge Replace)	11573 SF
**Scour Critical Rating (N113)	7

Deterioration Slope				
Item	Deterioration Line Equation			Year
	Slope =	Days	Years	Drop
Substr	y =	0.000300x	0.110x	-9.13
Superstr	y =	0.000500x	0.183x	-5.48
Deck	y =	0.000500x	0.183x	-5.48

Cost Multipliers		
Elevation > 4000ft	810	1.00
Pier Height > 30ft	18	1.00
Length to # span ratio	32.60	1.25
Skew > 30degrees	13.00	1.00
Project Cost Multiplier	All Options	2.20

L to # Span Multiplier	
L/ # Span Ratio	Multiplier
=>100	1.00
=>60	1.10
<60	1.25

Skew Multiplier	
Skew	Multiplier
<30	1.00
=>30	1.10

Adjusted Bridge Replace Cost	
Base Bridge Replacement Cost (Per SF)	$125.00
Bridge Replacement Cost w/ Multipliers (Per SF)	$156.25

Elevation Multiplier	
Elev	Multiplier
<4000	1.00
=>4000	1.25

Pier H Multiplier	
Pier H	Multiplier
<30	1.00
=>30	1.10

Bridge History (Inspections/As-builts)

Description	Category	Year
Bridge Inspection Report (2014): Hairline to wide transverse cracks on deck surface over bridge abutment joints, Overall deck has extensive hairline to medium cracks, Deck repair was recommended, Abutment walls have minor vertical cracks, Repair recommendation for the approach slabs		2014
Bridge Inspection Report: Similar to previous years. Recommended repairs: Repair the deck and approach slabs.		2014
Bridge Inspection Report: Similar to previous years. Recommended repairs: Repair the deck and approach slabs.		2012
Bridge Inspection Report: Similar to previous years. Recommended repairs: "based on the condition of the concrete deck wearing surface as well as the concrete approach slabs, a rehabilitation of these elements is in order."		2010
Bridge Inspection Report: Similar to previous years. Recommended repairs: repair clogged deck drains		2008
Bridge Inspection Report: Deck top has extensive fine to medium transverse and random cracks; Deck bottom has longitudinal and random cracking with efflorescence and dark leakage; barriers have minor fine vertical cracking. Superstructure: Concrete slab has random cracks and minor spalls on East fascia, partially patch. Substructure: Abutments have minor fine vertical cracking; piers have fine to medium vertical and diagonal cracking and minor spalling. AC roadway has medium cracks over abutments joints separating approach slabs from deck slabs. No recommended repairs		2006
Widened to 4 lanes		2006
Bridge Inspection Report: Deck bottom has longitudinal and random cracking with tan leakage; barriers have minor fine vertical cracking; concrete slab of superstructure has random crakcs; abutments have minor fine vertical cracking; piers have minor fine vertical and diagonal cracking; slope protection seems to be working. No recommended repairs		2004
As-built - initial construction (F-063-2-502)		1982

Replace / Rehab / Repair Information

BRIDGE DECK				
ITEM	**DESCRIPTION**	**UNIT COST (Per SF)**	**LIFE (YRS)**	**RATING BENEFIT**
Replace (Deck)	Full Deck Replacement	$78.13	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	$10.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	$5.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	$3.00	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	$156.25	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$3.00	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	$3.00	10	+ 0

SUPERSTRUCTURE - STEEL				
ITEM	**DESCRIPTION**	**UNIT COST (Per SF)**	**LIFE (YRS)**	**RATING BENEFIT**
Replace (Supr - Stl)	Full SuperStr Replacement	$78.13	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	$39.06	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	$5.00	See Deterioration Slope	+ 1

SUPERSTRUCTURE - CONCRETE				
ITEM	**DESCRIPTION**	**UNIT COST (Per SF)**	**LIFE (YRS)**	**RATING BENEFIT**
Replace (Supr - Conc)	Full SuperStr Replacement	$78.13	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	$39.06	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	$156.25	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	$3.00	10	+ 1

SUBSTRUCTURE - STRUCTURAL				
ITEM	**DESCRIPTION**	**UNIT COST (Per SF)**	**LIFE (YRS)**	**RATING BENEFIT**
Replace (Substr)	Full SubStr Replacement	$78.13	75	Rating = 8
Rehab (Substr)	Replace Structural Component	$39.06	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	$5.00	See Deterioration Slope	+ 1

SUBSTRUCTURE - SCOUR				
ITEM	**DESCRIPTION**	**UNIT COST (Per SF)**	**LIFE (YRS)**	**RATING BENEFIT**
Rehab (Substr - Scour)	Add scour protection slabs	$39.06	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	$156.25	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	$3.00	10	+ 1

	Substructure						*Superstructure*						*Deck*							*Summary*		
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 $ raw costs)	Present Value at 3%	Present Value at 7%
2015	6						5						5									
2016	6						5						5									
2017	6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
2018	6						5						5									
2019	6						5						5									
2020	6						4						4									
2021	8	Replace (Bridge)	$156.25	$1,808,281.25	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$1,808,281.25	$1,514,407.08	$1,204,934.15
2022	8						8						8						8			
2023	8						8						8						8			
2024	8						8						8						8			
2025	8						8						8						8			
2026	8						8						8						8			
2027	8						8						8						8			
2028	8						8						8						8			
2029	8						8						8						8			
2030	8						8						8						8			
2031	7						7						7						7			
2032	7						7						7						7			
2033	7						7						7						7			
2034	7						7						7						7			
2035	7						7						7						7			
2036	7						7						7						7			
2037	7						7						7						7			
2038	7						7						7						7			
2039	7						7						7						7			
2040	6						6						6						6			
2041	7	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 1	7	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 1	7	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 0	7	$104,157.00	$48,297.05	$17,935.37
2042	7						7						7						7			
2043	7						7						7						7			
2044	7						7						7						7			
2045	7						7						7						7			
2046	7						7						7						7			
2047	7						7						7						7			
2048	7						7						7						7			
2049	7						7						7						7			
2050	7						7						7						7			
2051	6						6						6						6			
2052	6						6						6						6			
2053	6						6						6						6			
2054	6						6						6						6			
2055	6						6						6						6			
2056	6						6						6						6			
2057	6						6						6						6			
2058	6						6						6						6			
2059	6						6						6						6			
2060	5						5						5						5			
2061	6	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 1	6	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 1	6	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 0	6	$104,157.00	$26,740.91	$4,634.84
2062	6						6						6						6			
2063	6						6						6						6			
2064	6						6						6						6			
2065	6						6						6						6			
2066	6						6						6						6			
2067	6						6						6						6			
2068	6						6						6						6			
2069	6						6						6						6			
2070	6						6						6						6			
2071	5						5						5						5			
2072	5						5						5						5			
2073	5						5						5						5			
2074	5						5						5						5			
2075	5						5						5						5			
2076	5						5						5						5			
2077	5						5						5						5			
2078	5						5						5						5			
2079	5						5						5						5			
2080	4						4						4						4			
																			Total Cost =	**$2,016,595.25**	**$1,589,445.04**	**$1,227,504.35**

	Substructure						Superstructure						Deck						Summary			
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 $ raw costs)	Present Value at 3%	Present Value at 7%
2015	6						5						5									
2016	6						5						5									
2017	6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
2018	6						5						5									
2019	6						5						5									
2020	6						4						4									
2021	6						6	Rehab (Supr - Conc)	$39.06	$452,070.31	15	+ 2	6	Rehab (Deck Concrete Overlay)	$10.00	$115,730.00	15	+ 2	6	$567,800.31	$475,523.82	$378,349.32
2022	6						6						6						6			
2023	6						6						6						6			
2024	5						6						6						5			
2025	5						6						6						5			
2026	5						6						6						5			
2027	5						5						5						5			
2028	5						5						5						5			
2029	5						5						5						5			
2030	5						5						5						5			
2031	5						5						5						5			
2032	5						5						5						5			
2033	4						4						5	Repair (After Rehab)	$3.00	$34,719.00	10	+ 0	4	$34,719.00	$20,393.75	$10,272.10
2034	6	Rehab (Substr)	$39.06	$452,070.31	50	+ 2	5	Repair (After Rehab)	$3.00	$34,719.00	10	+ 1	5						5	$486,789.31	$277,609.14	$134,601.30
2035	6						5						5						5			
2036	6						5						5						5			
2037	6						5						5						5			
2038	6						5						5						5			
2039	6						5						7	Rehab (Deck Concrete Overlay)	$10.00	$115,730.00	15	+ 2	5	$115,730.00	$56,931.49	$22,815.78
2040	6						4						7						4			
2041	6						5	Repair (Supr - Conc)	$5.00	$57,865.00	-5	+ 1	7						5	$57,865.00	$26,831.70	$9,964.09
2042	6						5						7						5			
2043	5						5						7						5			
2044	5						5						7						5			
2045	5						5						6						5			
2046	5						5						6						5			
2047	5						4						6						4			
2048	5	Repair (After Rehab)	$3.00	$34,719.00	10	+ 1	5	Repair (Supr - Conc)	$5.00	$57,865.00	-5	+ 1	6						5	$92,584.00	$34,906.60	$9,928.22
2049	5						5						6						5			
2050	5						5						6						5			
2051	5						5						5						5			
2052	5						5						5						5			
2053	5						5						5						5			
2054	5						4						5						4			
2055	5						5	Repair (Supr - Conc)	$5.00	$57,865.00	-5	+ 1	5						5	$57,865.00	$17,738.91	$3,864.25
2056	5						5						5						5			
2057	8	Replace (Bridge)	$156.25	$1,808,281.25	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$1,808,281.25	$522,519.55	$105,474.46
2058	8						8						8						8			
2059	8						8						8						8			
2060	8						8						8						8			
2061	8						8						8						8			
2062	8						8						8						8			
2063	8						8						8						8			
2064	8						8						8						8			
2065	8						8						8						8			
2066	8						8						8						8			
2067	7						8						8						7			
2068	7						8						8						7			
2069	7						7						7						7			
2070	7						7						7						7			
2071	7						7						7						7			
2072	7						7						7						7			
2073	7						7						7						7			
2074	7						7						7						7			
2075	7						6						6						6			
2076	6						6						6						6			
2077	7	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 1	7	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 1	6	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 0	6	$104,157.00	$16,664.05	$1,569.98
2078	7						7						6						6			
2079	7						7						6						6			
2080	7						7						6						6			
																			Total Cost =	$3,325,790.88	$1,449,119.01	$676,839.50

	Substructure						Superstructure						Deck						Summary			
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 $ raw costs)	Present Value at 3%	Present Value at 7%
2015	6	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
2016	6						5						5									
2017	6						5						5									
2018	6						5						5									
2019	6						5						5									
2020	6						4						4									
2021	6						5	Repair (Supr - Conc)	$5.00	$57,865.00	-5	+ 1	6	Rehab (Deck Concrete Overlay)	$10.00	$115,730.00	15	+ 2	5	$173,595.00	$145,383.08	$115,673.68
2022	6						5						6						5			
2023	6						5						6						5			
2024	5						5						6						5			
2025	5						5						6						5			
2026	5						5						6						5			
2027	5						4	Repair (Supr - Conc)	$5.00	$57,865.00	-5	+ 1	5						4	$57,865.00	$40,585.35	$25,692.75
2028	5						5						5						5			
2029	5						5						5						5			
2030	5						5						5						5			
2031	5						5						5						5			
2032	5						5						5	Repair (After Rehab)	$3.00	$34,719.00	10	+ 0	5	$34,719.00	$21,005.57	$10,991.15
2033	4						5						5						4			
2034	5	Repair (Substr)	$5.00	$57,865.00	-9	+ 1	4	Repair (Supr - Conc)	$5.00	$57,865.00	-5	+ 1	5						4	$115,730.00	$65,999.20	$32,000.31
2035	5						5						5						5			
2036	5						5						5						5			
2037	5						5						5	Repair (Deck)	$3.00	$34,719.00	-5	+ 0	5	$34,719.00	$18,119.59	$7,836.54
2038	5						5						5						5			
2039	5						5						5						5			
2040	5						5						5						5			
2041	5						4	Repair (Supr - Conc)	$5.00	$57,865.00	-5	+ 1	5						4	$57,865.00	$26,831.70	$9,964.09
2042	5						5						5						5			
2043	4						5						5	Repair (Deck)	$3.00	$34,719.00	-5	+ 0	4	$34,719.00	$15,174.87	$5,221.81
2044	5	Repair (Substr)	$5.00	$57,865.00	-9	+ 1	5						5						5	$57,865.00	$24,554.80	$8,133.67
2045	5						5						5						5			
2046	5						5						5						5			
2047	5						5						5						5			
2048	5						4	Repair (Supr - Conc)	$5.00	$57,865.00	-5	+ 1	5						4	$57,865.00	$21,816.62	$6,205.14
2049	5						5						5	Repair (Deck)	$3.00	$34,719.00	-5	+ 0	5	$34,719.00	$12,708.71	$3,479.52
2050	5						5						5						5			
2051	5						5						5						5			
2052	5						5						5						5			
2053	4						5	Repair (Supr - Conc)	$5.00	$57,865.00	-5	+ 1	5						4	$57,865.00	$18,819.21	$4,424.18
2054	5	Repair (Substr)	$5.00	$57,865.00	-9	+ 1	5						5	Repair (Deck)	$3.00	$34,719.00	-5	+ 0	5	$92,584.00	$29,233.73	$6,615.59
2055	5						5						5						5			
2056	5						5						5						5			
2057	8	Replace (Bridge)	$156.25	$1,808,281.25	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$1,808,281.25	$522,519.55	$105,474.46
2058	8						8						8						8			
2059	8						8						8						8			
2060	8						8						8						8			
2061	8						8						8						8			
2062	8						8						8						8			
2063	8						8						8						8			
2064	8						8						8						8			
2065	7						7						7						7			
2066	7						7						7						7			
2067	7						7						7						7			
2068	7						7						7						7			
2069	7						7						7						7			
2070	7						7						7						7			
2071	7						7						7						7			
2072	7						7						7						7			
2073	7						7						7						7			
2074	6						6						6						6			
2075	6						6						6						6			
2076	6						6						6						6			
2077	7	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 1	7	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 1	7	Repair (After Bridge Replace)	$3.00	$34,719.00	20	+ 0	7	$104,157.00	$16,664.05	$1,569.98
2078	7						7						7						7			
2079	7						7						7						7			
2080	7						7						7						7			
																			Total Cost =	$2,722,548.25	$979,416.02	$343,282.85

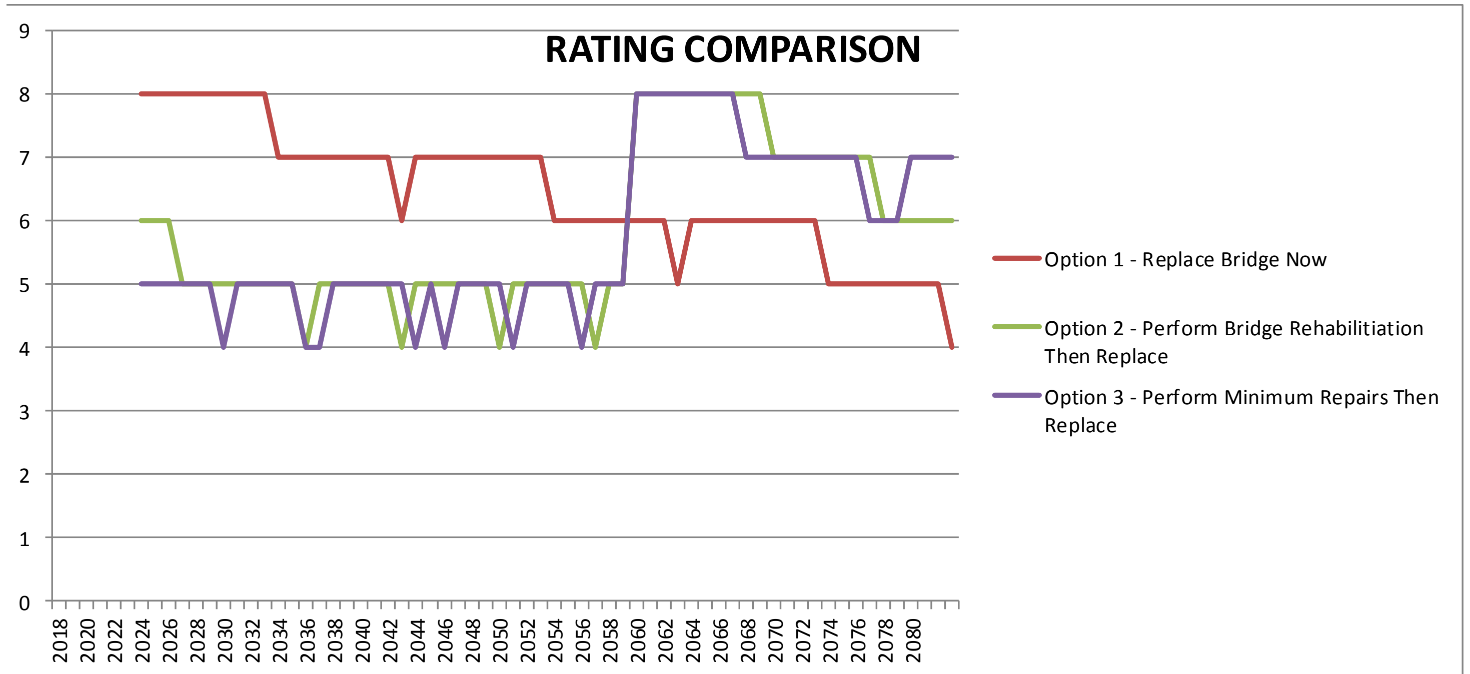
Mockingbird Wash Bridge (#1915) / SR 95 / MP 178.26

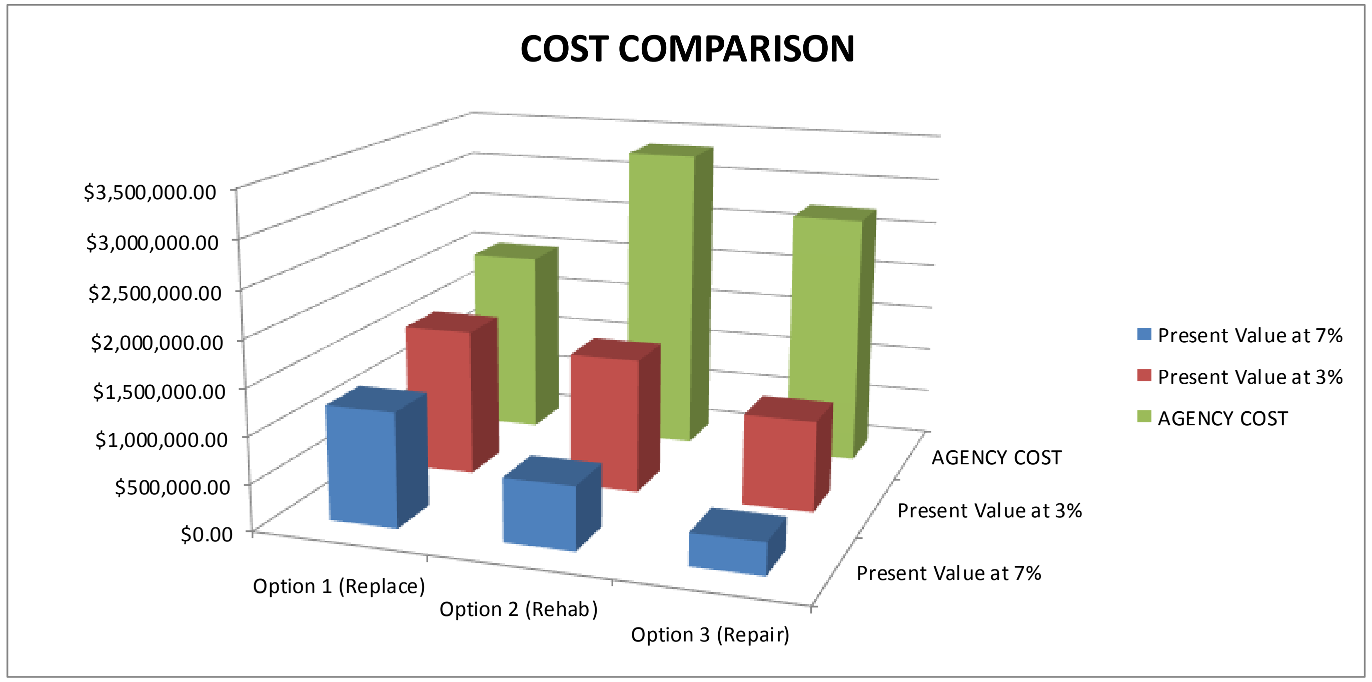
COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	$ 2,016,595.25	$1,589,445.04	$1,227,504.35
Option 2 (Rehab)	$ 3,325,790.88	$1,449,119.01	$676,839.50
Option 3 (Repair)	$ 2,722,548.25	$979,416.02	$343,282.85

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	60.64%	109.68%	181.36%
3 (Repair)	74.07%	162.28%	357.58%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	$4,436,510	$3,496,779	$2,700,510
Option 2 (Rehab)	$7,316,740	$3,188,062	$1,489,047
Option 3 (Repair)	$5,989,606	$2,154,715	$755,222

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	4
Option 2 (Rehab)	5.85	6
Option 3 (Repair)	5.77	7





Bouse Wash Bridge (#1321) / SR 95 / MP 131.33

Bridge Information	
Bridge Deck Area (A225)	21491 SF
Year Built (N27)	1970
Exp Service Life	75 YR
Total Bridge Length (N49)	584 LF
Number of Spans (N45+N46)	17
Skew Angle (N34)	0 DEG
Average Elevation	624 FT
Max Pier Height	23 FT
* Amount of Widening for Bridge	6 FT
Revised Deck Area (Bridge Replace)	24995 FT
**Scour Critical Rating (N113)	7

Deterioration Slope				
Item	Deterioration Line Equation			Year
	Slope =	Days	Years	Drop
Substr	y =	0.000300x	0.110x	-9.13
Superstr	y =	0.000400x	0.146x	-6.85
Deck	y =	0.000400x	0.146x	-6.85

Cost Multipliers		
Elevation > 4000ft	624	1.00
Pier Height > 30ft	23	1.00
Length to # span ratio	34.35	1.25
Skew > 30degrees	0.00	1.00
Project Cost Multiplier	All Options	2.20

L to # Span Multiplier	
L/ # Span Ratio	Multiplier
=>100	1.00
=>60	1.10
<60	1.25

Skew Multiplier	
Skew	Multiplier
<30	1.00
=>30	1.10

Adjusted Bridge Replace Cost	
Base Bridge Replacement Cost (Per SF)	$125.00
Bridge Replacement Cost w/ Multipliers (Per SF)	$156.25

Elevation Multiplier	
Elev	Multiplier
<4000	1.00
=>4000	1.25

Pier H Multiplier	
Pier H	Multiplier
<30	1.00
=>30	1.10

Bridge History (Inspections/As-builts)

Description	Category	Year
Bridge Inspection Report (2014): Extensive hairline to medium longitudinal cracking, Fair Deck Rating (5), Random horizontal cracking on piers		2014
Bridge Inspection Report (2012): Pier columns have small hairline horizontal and random cracks, Minor cour around the pier columns		2012
Bridge Inspection Report: The concrete deck wearing surface has extensive hairline to fine to medium sized longitudinal and map cracks. There is minor rutting of the traveled lanes.		2010
Bridge Inspection Report : Deck surface has extensive hairline to medium sized longitudinal and map cracks; Deck underside has hairline sized longitudinal and few map cracks; curbs have minor hairline sized vertical cracks; east railing at bottom near south joint has minor dent; there is debri in joints and in the shoulder area long curbe lines.		2008
Bridge Inspection Report: Deck top has extensive minor fine random cracking and debri deposited in shoulder; deck bottom has hairline longitudinal cracking; curbs have extensive minor fine vertical cracking; east railing at bottom near shout joint has minor dent; hinges are somewhat rusty on bottom.		2006
Bridge Inspection Report: Deck top has extensive minor fine random cracking; deck bottom has hairline longitudinal cracking; curbs have extensive minor fine vertical cracking.		2004
As-builts- Initial construction (S-264-505)		1969

Replace / Rehab / Repair Information

BRIDGE DECK				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Deck)	Full Deck Replacement	$78.13	25	Rating = 8
Rehab (Deck Concrete Overlay)	Overlay (Concrete)	$10.00	15	+ 2
Rehab (Deck Epoxy Overlay)	Overlay (Epoxy)	$5.00	10	+ 1
Repair (Deck)	Patch Spalls / Seal Cracks	$3.00	See Deterioration Slope	+ 0
Replace (Bridge)	Full Bridge Replacement	$156.25	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$3.00	20	+ 0
Repair (After Rehab)	Patch Spalls / Seal Cracks	$3.00	10	+ 0

SUPERSTRUCTURE - STEEL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Stl)	Full SuperStr Replacement	$78.13	50	Rating = 8
Rehab (Supr - Stl)	Weld New Structural Components	$39.06	15	+ 2
Repair (Supr - Stl)	Weld Repair / Crack Relief	$5.00	See Deterioration Slope	+ 1

SUPERSTRUCTURE - CONCRETE				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Supr - Conc)	Full SuperStr Replacement	$78.13	50	Rating = 8
Rehab (Supr - Conc)	Replace Structural Component	$39.06	15	+ 2
Repair (Supr - Conc)	Patch Spalls / Seal Cracks	$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	$156.25	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	$3.00	10	+ 1

SUBSTRUCTURE - STRUCTURAL				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Replace (Substr)	Full SubStr Replacement	$78.13	75	Rating = 8
Rehab (Substr)	Replace Structural Component	$39.06	50	+ 2
Repair (Substr)	Patch Spalls / Seal Cracks	$5.00	See Deterioration Slope	+ 1

SUBSTRUCTURE - SCOUR				
ITEM	DESCRIPTION	UNIT COST (Per SF)	LIFE (YRS)	RATING BENEFIT
Rehab (Substr - Scour)	Add scour protection slabs	$39.06	50	+ 2
Repair (Substr - Scour)	Patch Spalls / Seal Cracks	$5.00	See Deterioration Slope	+ 1
Replace (Bridge)	Full Bridge Replacement	$156.25	75	Rating = 8
Repair (After Bridge Replace)	Patch Spalls / Seal Cracks	$3.00	20	+ 1
Repair (After Rehab)	Patch Spalls / Seal Cracks	$3.00	10	+ 1

	Substructure						*Superstructure*						*Deck*							*Summary*		
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 $ raw costs)	Present Value at 3%	Present Value at 7%
2015	7	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
2016	7						5						5									
2017	7						5						5									
2018	7						5						5									
2019	7						5						5									
2020	7						5						5									
2021	8	Replace (Bridge)	$156.25	$3,905,468.75	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$3,905,468.75	$3,270,768.59	$2,602,378.73
2022	8						8						8						8			
2023	8						8						8						8			
2024	8						8						8						8			
2025	8						8						8						8			
2026	8						8						8						8			
2027	8						8						8						8			
2028	8						8						8						8			
2029	8						8						8						8			
2030	8						8						8						8			
2031	7						7						7						7			
2032	7						7						7						7			
2033	7						7						7						7			
2034	7						7						7						7			
2035	7						7						7						7			
2036	7						7						7						7			
2037	7						7						7						7			
2038	7						7						7						7			
2039	7						7						7						7			
2040	6	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 1	6	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 1	6	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 0	6	$224,955.00	$107,439.76	$41,447.77
2041	7						7						7						7			
2042	7						7						7						7			
2043	7						7						7						7			
2044	7						7						7						7			
2045	7						7						7						7			
2046	7						7						7						7			
2047	7						7						7						7			
2048	7						7						7						7			
2049	7						7						7						7			
2050	7						7						7						7			
2051	6						6						6						6			
2052	6						6						6						6			
2053	6						6						6						6			
2054	6						6						6						6			
2055	6						6						6						6			
2056	6						6						6						6			
2057	6						6						6						6			
2058	6						6						6						6			
2059	6						6						6						6			
2060	5	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 1	5	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 1	5	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 0	5	$224,955.00	$59,486.79	$10,710.89
2061	6						6						6						6			
2062	6						6						6						6			
2063	6						6						6						6			
2064	6						6						6						6			
2065	6						6						6						6			
2066	6						6						6						6			
2067	6						6						6						6			
2068	6						6						6						6			
2069	6						6						6						6			
2070	6						6						6						6			
2071	5						5						5						5			
2072	5						5						5						5			
2073	5						5						5						5			
2074	5						5						5						5			
2075	5						5						5						5			
2076	5						5						5						5			
2077	5						5						5						5			
2078	5						5						5						5			
2079	5						5						5						5			
2080	4						4						4						4			
																			Total Cost =	$4,355,378.75	$3,437,695.14	$2,654,537.40

	Substructure						Superstructure						Deck						Summary			
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 $ raw costs)	Present Value at 3%	Present Value at 7%
2015	7						5						5									
2016	7						5						5									
2017	7	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
2018	7						5						5									
2019	7						5						5									
2020	7						5						5									
2021	8						5						5						5			
2022	8						4	Rehab (Supr - Conc)	$39.06	$839,492.19	15	+ 2	4	Rehab (Deck Concrete Overlay)	$10.00	$214,910.00	15	+ 2	4	$1,054,402.19	$857,325.47	$656,628.69
2023	8						6						6						6			
2024	8						6						6						6			
2025	8						6						6						6			
2026	8						6						6						6			
2027	8						6						6						6			
2028	8						6						6						6			
2029	8						6						6						6			
2030	8						5						5						5			
2031	7						5						5						5			
2032	7						5						5						5			
2033	7						5						5						5			
2034	7						5						5						5			
2035	7						5						5						5			
2036	7						5						5	Repair (After Rehab)	$3.00	$64,473.00	10	+ 0	5	$64,473.00	$34,657.41	$15,571.07
2037	7						4	Repair (After Rehab)	$3.00	$64,473.00	10	+ 1	5						4	$64,473.00	$33,647.98	$14,552.40
2038	7						5						5						5			
2039	6						5						5						5			
2040	6						5						5						5			
2041	6						5						5						5			
2042	6						5						5						5			
2043	6						5						5						5			
2044	6						5						4						4			
2045	8	Replace (Bridge)	$156.25	$3,905,468.75	75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$3,905,468.75	$1,609,001.41	$513,050.17
2046	8						8						8						8			
2047	8						8						8						8			
2048	8						8						8						8			
2049	8						8						8						8			
2050	8						8						8						8			
2051	8						8						8						8			
2052	8						7						7						7			
2053	8						7						7						7			
2054	7						7						7						7			
2055	7						7						7						7			
2056	7						7						7						7			
2057	7						7						7						7			
2058	7						7						7						7			
2059	7						7						7						7			
2060	7						6						6						6			
2061	7						6						6						6			
2062	7						6						6						6			
2063	6						6						6						6			
2064	7	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 1	7	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 1	7	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 0	7	$224,955.00	$52,853.24	$8,171.29
2065	7						7						7						7			
2066	7						7						7						7			
2067	7						7						7						7			
2068	7						7						7						7			
2069	7						7						7						7			
2070	7						7						7						7			
2071	7						6						6						6			
2072	6						6						6						6			
2073	6						6						6						6			
2074	6						6						6						6			
2075	6						6						6						6			
2076	6						6						6						6			
2077	6						6						6						6			
2078	6						5						5						5			
2079	6						5						5						5			
2080	6						5						5						5			
																			Total Cost =	$5,313,771.94	$2,587,485.52	$1,207,973.63

	Substructure						Superstructure						Deck						Summary			
Year	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Rating	Item	Cost (Per SF)	Cost (Total)	Service Life	Rating Increase	Minimum Rating	Total Cost Per Year (2015 $ raw costs)	Present Value at 3%	Present Value at 7%
2015	7						5						5									
2016	7						5						5									
2017	7	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.					5	No Rehab/Repair Work Can Be Done. Not Yet In 5-Year Program.								
2018	7						5						5									
2019	7						5						5									
2020	7						5						5									
2021	8						5						5	Repair (Deck)	$3.00	$64,473.00	-7	+ 0	5	$64,473.00	$53,995.12	$42,961.08
2022	8						4						5						4			
2023	8						5	Repair (Supr - Conc)	$5.00	$107,455.00	-7	+ 1	5						5	$107,455.00	$84,825.97	$62,539.79
2024	8						5						5						5			
2025	8						5						5						5			
2026	8						5						5						5			
2027	8						5						5						5			
2028	8						5						5	Repair (Deck)	$3.00	$64,473.00	-7	+ 0	5	$64,473.00	$43,902.98	$26,754.00
2029	8						5						5						5			
2030	8						4	Repair (Supr - Conc)	$5.00	$107,455.00	-7	+ 1	5						4	$107,455.00	$68,971.28	$38,946.64
2031	7						5						5						5			
2032	7						5						5						5			
2033	7						5						5						5			
2034	7						5						5						5			
2035	7						5						5	Repair (Deck)	$3.00	$64,473.00	-7	+ 0	5	$64,473.00	$35,697.14	$16,661.05
2036	7						5						5						5			
2037	7						5						5						5			
2038	7						4	Repair (Supr - Conc)	$5.00	$107,455.00	-7	+ 1	5						4	$107,455.00	$54,446.56	$22,667.30
2039	6						5						5						5			
2040	6						5						5						5			
2041	6						5						5	Repair (Deck)	$3.00	$64,473.00	-7	+ 0	5	$64,473.00	$29,895.79	$11,101.96
2042	6						5						5						5			
2043	6						5						5						5			
2044	6						5						5						5			
2045	8	Replace (Bridge)	$156.25	$3,905,468.75	75	Rating = 8	8	Replace (Supr - Conc)	$78.13	$1,678,984.38	50	Rating = 8	8	Replace (Bridge)			75	Rating = 8	8	$5,584,453.13	$2,300,720.75	$733,613.51
2046	8						8						8						8			
2047	8						8						8						8			
2048	8						8						8						8			
2049	8						8						8						8			
2050	8						8						8						8			
2051	8						8						8						8			
2052	8						8						8						8			
2053	8						8						8						8			
2054	8						8						8						8			
2055	7						7						7						7			
2056	7						7						7						7			
2057	7						7						7						7			
2058	7						7						7						7			
2059	7						7						7						7			
2060	7						7						7						7			
2061	7						7						7						7			
2062	7						7						7						7			
2063	7						7						7						7			
2064	6						6						6						6			
2065	7	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 1	7	Repair (After Bridge Replace)	$3.00	$64,473.00	20	+ 1	7	Repair (After Bridge Replace)	$3.00	$74,985.00	20	+ 0	7	$214,443.00	$48,915.97	$7,279.86
2066	7						7						7						7			
2067	7						7						7						7			
2068	7						7						7						7			
2069	7						7						7						7			
2070	7						7						7						7			
2071	7						7						7						7			
2072	7						7						7						7			
2073	7						7						7						7			
2074	7						7						7						7			
2075	6						6						6						6			
2076	6						6						6						6			
2077	6						6						6						6			
2078	6						6						6						6			
2079	6						6						6						6			
2080	6						6						6						6			
																			Total Cost =	$6,379,153.13	$2,721,371.55	$962,525.18

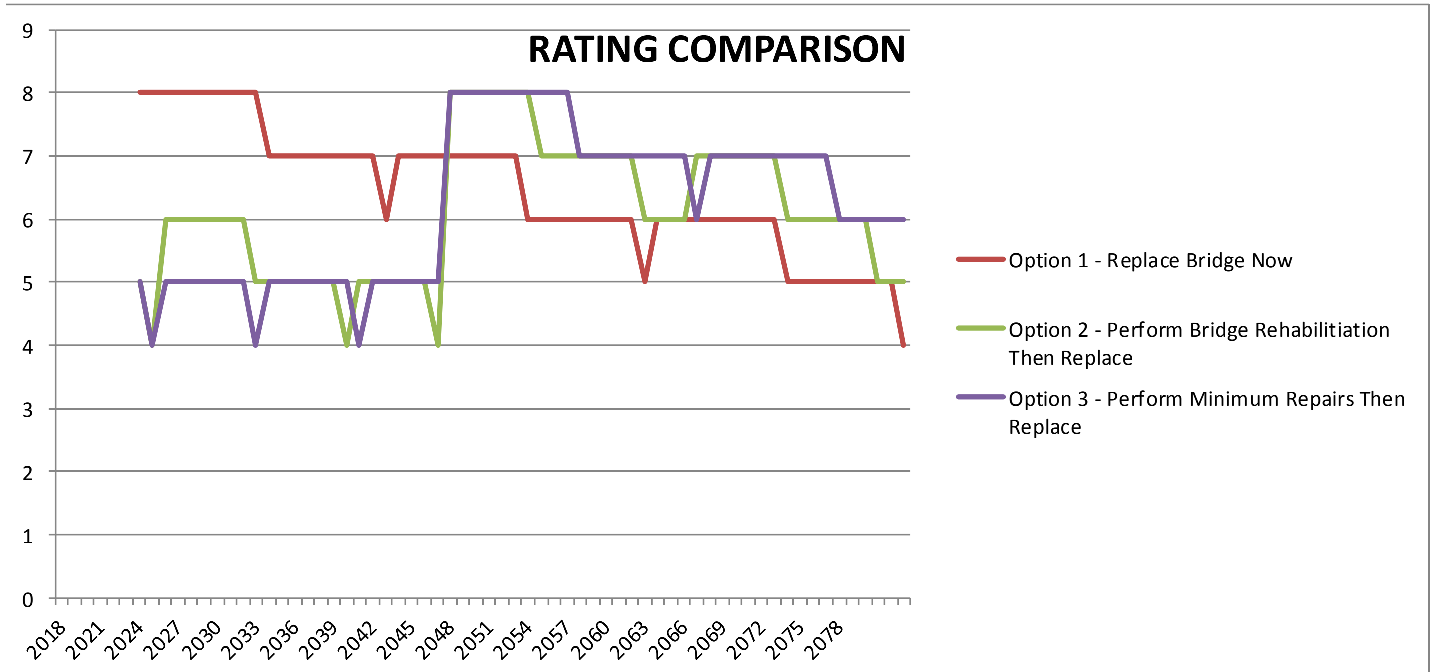
Bouse Wash Bridge (#1321) / SR 95 / MP 131.33

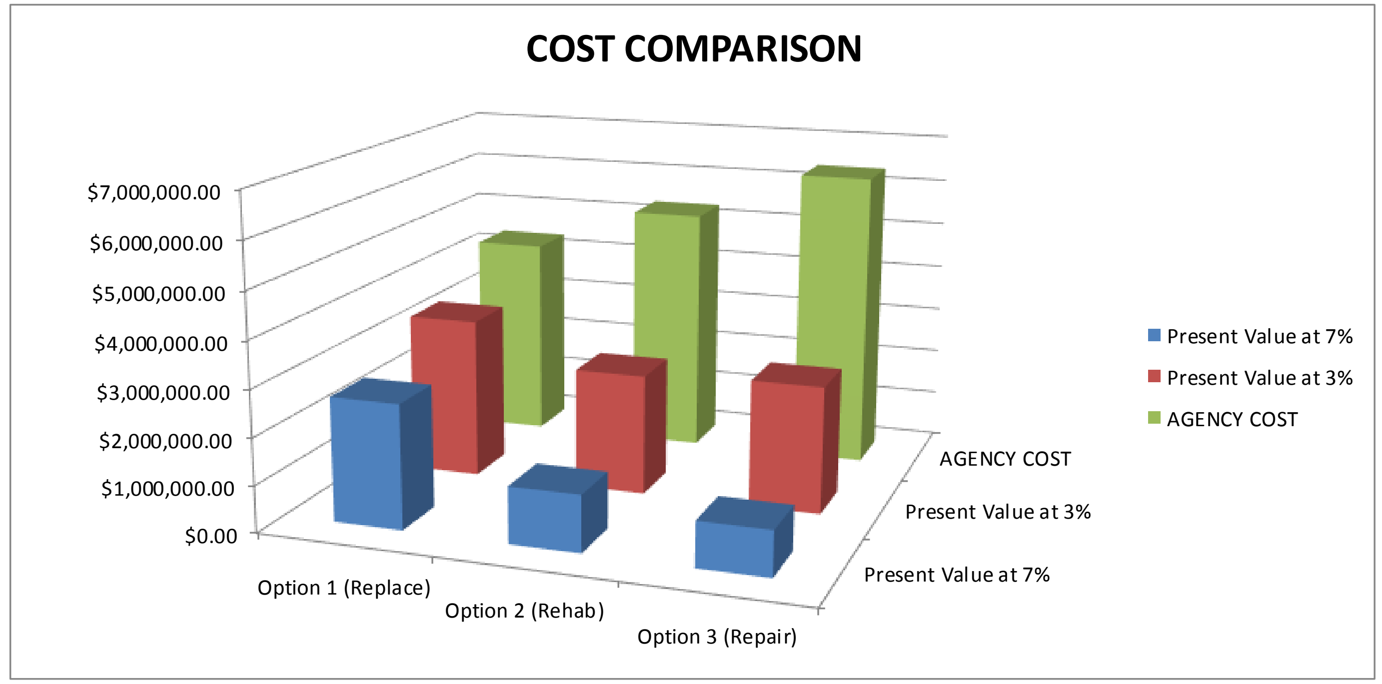
COST COMPARISON Present Value 2015 Dollars - Raw Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	$ 4,355,378.75	$3,437,695.14	$2,654,537.40
Option 2 (Rehab)	$ 5,313,771.94	$2,587,485.52	$1,207,973.63
Option 3 (Repair)	$ 6,379,153.13	$2,721,371.55	$962,525.18

Comparison to Replacement			
Option	Agency Cost	3%	7%
2 (Rehab)	81.96%	132.86%	219.75%
3 (Repair)	68.28%	126.32%	275.79%

COST COMPARISON Present Value 2015 Dollars - Fully Loaded Costs			
OPTION	AGENCY COST	3%	7%
Option 1 (Replace)	$9,581,833	$7,562,929	$5,839,982
Option 2 (Rehab)	$11,690,298	$5,692,468	$2,657,542
Option 3 (Repair)	$14,034,137	$5,987,017	$2,117,555

Bridge Ratings Per Option		
OPTION	AVG RATING	END RATING
Option 1 (Replace)	6.45	4
Option 2 (Rehab)	6.10	5
Option 3 (Repair)	6.20	6





Pavement LCCA

Project Details	
Project title	SR 95 Corridor Profile Study
Route	SR 95
Milepost begin	116
Milepost end	121

Existing Roadway Characteristics			
Surface type (Asphalt or Concrete)	=	Asphalt	<<Select from Pull-down List>>
# of directions of travel (1 = one-way; 2 = two-way)	=	2	
# of lanes (in one direction)	=	1	
Width of typical lane (ft)	=	12	
Left shoulder width (ft)	=	2	
Right shoulder width (ft)	=	2	
Total roadway analysis segment length (centerline miles)	=	5	
Current year	=	2016	
Elevation (> 4,000 ft or < 4,000 ft)?	=	< 4,000 ft	<<Select from Pull-down List>>
Roadway width (ft) [each direction lanes & shoulders]	=	16	
Total lane-miles [total traffic direction lanes & shoulders]	=	13.3	
Total square feet [total traffic direction lanes & shoulders]	=	844,800	
Total square yards [total traffic direction lanes & shoulders]	=	93,867	

LCCA Parameters		
Analysis period (years)	=	40
Year of net present value	=	2017
First year of improvements	=	2021
Discount rate (%) - low	=	3%
Discount rate (%) - high	=	7%

Design Alternatives (DA)

Characteristics			Pavement Material Cost ($)		
Treatment Type	*Pavement Thickness*	*Typical Service Life (years)*	*Lane-miles*	*Square Feet*	*Square Yards*
Concrete Reconstruction	8"-12"	30-34	$350,000	$5.5	$50
Asphalt Reconstruction	8"-12"	26-30	$280,000	$4.4	$40
Concrete Medium Rehab	1"-3"	24-28	$75,000	$1.2	$11
Concrete Light Rehab	<1"	18-22	$50,000	$0.8	$7
Asphalt Medium Rehab	3"-8"	20-24	$105,000	$1.7	$15
Asphalt Light Rehab	<3"	14-18	$70,000	$1.1	$10

Reconstruction: Other Materials Cost Factor
1.60

Rehab: Other Materials Cost Factor
1.20

Total Cost Factor (e.g., includes design, mobilization, traffic control, contingency, etc.)
2.44

			Total Unit Cost ($) [includes material costs and indirect costs]			Total Bi-Directional Cost ($)
Treatment Type	Pavement Thickness	Typical Service Life (years)	Lane-miles	Square Feet	Square Yards	Total Cost
Concrete Reconstruction	8"-12"	30-34	$1,366,400	$21.6	$194	$18,218,667
Asphalt Reconstruction	8"-12"	26-30	$1,093,120	$17.3	$155	$14,574,933
Concrete Medium Rehab	1"-3"	24-28	$219,600	$3.5	$31	$2,928,000
Concrete Light Rehab	<1"	18-22	$146,400	$2.3	$21	$1,952,000
Asphalt Medium Rehab	3"-8"	20-24	$307,440	$4.9	$44	$4,099,200
Asphalt Light Rehab	<3"	14-18	$204,960	$3.2	$29	$2,732,800

Pavement Service Life, Intervals, and Sequence of Improvements

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Design Alternative	Typical Service Life Value	Typical Service Life Range	Average Historical Interval Value	Interval to Use in LCCA Before Reconstruction	Interval to Use in LCCA After Reconstruction
Concrete Reconstruction	32	30-34	0	-	16
Asphalt Reconstruction	28	26-30	25	-	14
Concrete Medium Rehab	26	24-28	0	13	13
Concrete Light Rehab	20	18-22	0	10	10
Asphalt Medium Rehab	22	20-24	25	11	11
Asphalt Light Rehab	16	14-18	14.5	8	8
None	0	0	-	-	-

Note: The typical service life values and ranges are determined based on the elevation of the roadway segment using the reference tables below. The typical service life values should be used as the intervals between improvements in the design alternatives except when historical frequency values are available based on the frequency and type of improvements in the past at this location. Historical frequency values should only be used if they are lower than the typical values and only up until reconstruction is implemented, after which typical service life values should be used.

Elevation Below 4000' (Desert Environment)		
Design Alternative	Typical Service Life Value	Typical Service Life Range
Concrete Reconstruction	32	30-34
Asphalt Reconstruction	28	26-30
Concrete Medium Rehab	26	24-28
Concrete Light Rehab	20	18-22
Asphalt Medium Rehab	22	20-24
Asphalt Light Rehab	16	14-18
None	0	0

Elevation Above 4000' (Mountain Environment)		
Design Alternative	Typical Service Life Value	Typical Service Life Range
Concrete Reconstruction	28	26-30
Asphalt Reconstruction	24	22-26
Concrete Medium Rehab	22	20-24
Concrete Light Rehab	16	14-18
Asphalt Medium Rehab	18	16-20
Asphalt Light Rehab	12	10-14
None	0	0

Assumed LCCA Sequence of Improvements Based on the Initial Design Alternative Improvement	
Concrete Reconstruction (CR):	CR, CLR, CMR, CLR, CR, CLR, CMR. . .
Asphalt Reconstruction (AR):	AR, ALR, AMR, ALR, AR, ALR, AMR. . .
Concrete Medium Rehab (CMR):	CMR, CLR, CR, CLR, CMR, CLR, CR. . .
Concrete Light Rehab (CLR):	CLR, CR, CLR, CMR, CLR, CR, CLR. . .
Asphalt Medium Rehab (AMR):	AMR, ALR, AR, ALR, AMR, ALR, AR. . .
Asphalt Light Rehab (ALR):	ALR, AR, ALR, AMR, ALR, AR, ALR. . .

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Year	Project Number	Tracs No.	Direction of Improvement	Treatment Type	Improvement Description	Thickness (inches)	Beg. MP	End MP	Length (miles)
1956			NB/SB	Asphalt Light Rehab	Bituminous Treated Surface	2.0	109.1	118.6	9.5
1957	x		NB/SB	Asphalt Light Rehab	Bituminous Treated Surface	2.0	118.6	131.02	12.42
1975	x		NB/SB	Asphalt Light Rehab	Seal Coat - Cover Material With Emulsified Asphalt [0.3]	0.3	110	134	24
1995			NB/SB	Asphalt Medium Rehab	Asphaltic Concrete	2.5	111.82	116.2	4.38
					ACFC Asphaltic Concrete Friction Course	0.5	111.82	116.2	4.38
2000	x		NB/SB	Asphalt Medium Rehab	Asphaltic Concrete	3.0	115.9	126.05	10.15
					ACFC Asphaltic Concrete Friction Course	0.5	115.9	126.05	10.15
2000	x		NB	Asphalt Reconstruction	Aggregate Base	4.0	116	117.64	1.64
					Asphaltic Concrete	5.0	116	117.64	1.64
					ACFC Asphaltic Concrete Friction Course	0.5	116	117.64	1.64
2000	x		SB	Asphalt Reconstruction	Aggregate Base	4.0	117.83	119.48	1.65
					Asphaltic Concrete	5.0	117.83	119.48	1.65
					ACFC Asphaltic Concrete Friction Course	0.5	117.83	119.48	1.65
2011	x		SB	Asphalt Light Rehab	Crack Seal (Rubberized)	0.0	109.05	128.5	19.45
2011			NB	Asphalt Light Rehab	Crack Seal (Rubberized)	0.0	116.06	117.3	1.24
2012			NB	Asphalt Light Rehab	Crack Seal (Rubberized)	0.0	118.16	119.45	1.29

Interval between Improvements in Years

Asphalt Reconstruction	25
Asphalt Medium Rehab	25
Asphalt Light Rehab	18
Asphalt Light Rehab	11

Treatment Type Options	Estimated Historical Interval Value between Improvements in Years
Concrete Reconstruction	
Asphalt Reconstruction	25
Concrete Medium Rehab	
Concrete Light Rehab	
Asphalt Medium Rehab	25
Asphalt Light Rehab	15

Design Alternative # 1 - Concrete Reconstruction

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Enter Name of Design Alternative

Number of Years	Year	Concrete Reconstruction	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Concrete Reconstruction	$18,218,667	$16,187,049	$13,898,934
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	None	$0	$0	$0
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	None	$0	$0	$0
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	None	$0	$0	$0
20	2036	None	$0	$0	$0
21	2037	Concrete Light Rehab	$1,952,000	$1,080,775	$504,434
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	None	$0	$0	$0
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	None	$0	$0	$0
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	Concrete Medium Rehab	$2,928,000	$1,206,297	$384,643
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	None	$0	$0	$0
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	None	$0	$0	$0
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	Concrete Light Rehab	$1,952,000	$547,620	$106,409
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Concrete Light Rehab	$1,854,400	$505,086	$94,475
Enter Year of Last Used DA Improvement ››		2060	Remaining Service Life Cost ^^		

		Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE		$18,516,655	$14,799,944
AGENCY COST		$23,196,267	

Design Alternative # 2 - Asphalt Reconstruction

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Enter Name of Design Alternative

Number of Years	Year	Asphalt Reconstruction	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Asphalt Reconstruction	$14,574,933	$12,949,639	$11,119,147
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	None	$0	$0	$0
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	None	$0	$0	$0
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	Asphalt Light Rehab	$2,732,800	$1,605,232	$808,537
20	2036	None	$0	$0	$0
21	2037	None	$0	$0	$0
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	None	$0	$0	$0
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	Asphalt Medium Rehab	$4,099,200	$1,900,777	$705,864
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	None	$0	$0	$0
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	None	$0	$0	$0
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	Asphalt Light Rehab	$2,732,800	$915,441	$223,567
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	None	$0	$0	$0
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Asphalt Light Rehab	$1,537,200	$418,690	$78,315
Enter Year of Last Used DA Improvement ››		2054	Remaining Service Life Cost ^^		

		Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE		$16,952,400	$12,778,800
AGENCY COST		$22,602,533	

Design Alternative # 3 - Asphalt Medium Rehab

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Enter Name of Design Alternative

Number of Years	Year	Asphalt Medium Rehab Focus	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Asphalt Medium Rehab	$4,099,200	$3,642,086	$3,127,260
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	None	$0	$0	$0
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	Asphalt Light Rehab	$2,732,800	$1,754,080	$990,492
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	None	$0	$0	$0
20	2036	None	$0	$0	$0
21	2037	None	$0	$0	$0
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	Asphalt Reconstruction	$14,574,933	$7,384,998	$3,074,537
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	None	$0	$0	$0
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	None	$0	$0	$0
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	None	$0	$0	$0
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	Asphalt Light Rehab	$2,732,800	$915,441	$223,567
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	None	$0	$0	$0
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Asphalt Light Rehab	$1,537,200	$418,690	$78,315
Enter Year of Last Used DA Improvement ››		2054	Remaining Service Life Cost ^^		

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$13,277,916	$7,337,542
AGENCY COST	$22,602,533	

Design Alternative # 4 - Asphalt Light Rehab

SR 95 MP 116 - MP 121

Enter Name of Design Alternative

Number of Years	Year	Asphalt Light Rehab Focus	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Asphalt Light Rehab	$2,732,800	$2,428,057	$2,084,840
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	Asphalt Reconstruction	$14,574,933	$10,222,565	$6,471,445
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	None	$0	$0	$0
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	None	$0	$0	$0
20	2036	None	$0	$0	$0
21	2037	None	$0	$0	$0
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	None	$0	$0	$0
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	Asphalt Light Rehab	$2,732,800	$1,267,185	$470,576
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	None	$0	$0	$0
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	Asphalt Medium Rehab	$4,099,200	$1,500,491	$410,819
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	None	$0	$0	$0
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	None	$0	$0	$0
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Asphalt Medium Rehab	$2,235,927	$609,003	$113,913
Enter Year of Last Used DA Improvement ››		2051	Remaining Service Life Cost ^^		

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$14,809,295	$9,323,767
AGENCY COST	$21,903,806	

Summary of LCCA Results

SR 95 MP 116 - MP 121

	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehab Focus	Asphalt Light Rehab Focus
Net Present Value - 3%	$18,516,655	$16,952,400	$13,277,916	$14,809,295
Net Present Value - 7%	$14,799,944	$12,778,800	$7,337,542	$9,323,767
Agency Cost	$23,196,267	$22,602,533	$22,602,533	$21,903,806

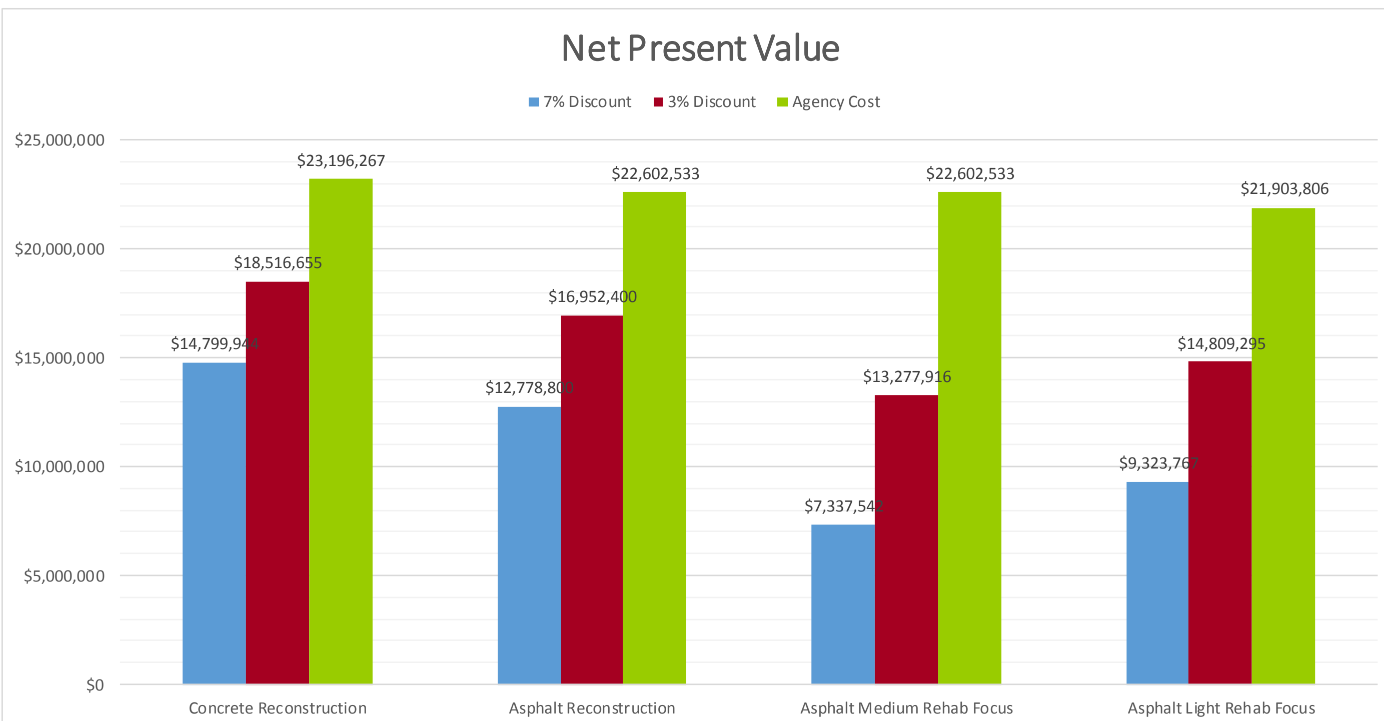
Cost Ratio at 3% Discount Rate

1.39 Ratio of Concrete Reconstruction to Lowest Cost Rehab
1.28 Ratio of Asphalt Reconstruction to Lowest Cost Rehab

Cost Ratio at 7% Discount Rate

2.02 Ratio of Concrete Reconstruction to Lowest Cost Rehab
1.74 Ratio of Asphalt Reconstruction to Lowest Cost Rehab

Note: A cost ratio < 1.15 means the Net Present Value (NPV) of reconstruction is within 15% of the NPV of the lowest cost rehab so reconstruction should likely be the initial improvement solution. A cost ratio > 1.15 means the NPV of reconstruction is more than 15% of the NPV of the lowest cost rehab so rehab should likely be the initial improvement solution.



Pavement Life-Cycle Cost Analysis Worksheet

Project Details	
Project title	SR 95 Corridor Profile Study
Route	SR 95
Milepost begin	148
Milepost end	149

Existing Roadway Characteristics			
Surface type (Asphalt or Concrete)	=	Asphalt	<<Select from Pull-down List>>
# of directions of travel (1 = one-way; 2 = two-way)	=	2	
# of lanes (in one direction)	=	2	
Width of typical lane (ft)	=	12	
Left shoulder width (ft)	=	6	
Right shoulder width (ft)	=	6	
Total roadway analysis segment length (centerline miles)	=	1	
Current year	=	2016	
Elevation (> 4,000 ft or < 4,000 ft)?	=	< 4,000 ft	<<Select from Pull-down List>>
Roadway width (ft) [each direction lanes & shoulders]	=	36	
Total lane-miles [total traffic direction lanes & shoulders]	=	6.0	
Total square feet [total traffic direction lanes & shoulders]	=	380,160	
Total square yards [total traffic direction lanes & shoulders]	=	42,240	

LCCA Parameters		
Analysis period (years)	=	40
Year of net present value	=	2017
First year of improvements	=	2021
Discount rate (%) - low	=	3%
Discount rate (%) - high	=	7%

Design Alternatives (DA)

Characteristics			Pavement Material Cost ($)		
Treatment Type	*Pavement Thickness*	*Typical Service Life (years)*	*Lane-miles*	*Square Feet*	*Square Yards*
Concrete Reconstruction	8"-12"	30-34	$350,000	$5.5	$50
Asphalt Reconstruction	8"-12"	26-30	$280,000	$4.4	$40
Concrete Medium Rehab	1"-3"	24-28	$75,000	$1.2	$11
Concrete Light Rehab	<1"	18-22	$50,000	$0.8	$7
Asphalt Medium Rehab	3"-8"	20-24	$105,000	$1.7	$15
Asphalt Light Rehab	<3"	14-18	$70,000	$1.1	$10

Reconstruction: Other Materials Cost Factor
1.60

Rehab: Other Materials Cost Factor
1.20

Total Cost Factor (e.g., includes design, mobilization, traffic control, contingency, etc.)
2.44

			Total Unit Cost ($) [includes material costs and indirect costs]			Total Bi-Directional Cost ($)
Treatment Type	Pavement Thickness	Typical Service Life (years)	Lane-miles	Square Feet	Square Yards	Total Cost
Concrete Reconstruction	8"-12"	30-34	$1,366,400	$21.6	$194	$8,198,400
Asphalt Reconstruction	8"-12"	26-30	$1,093,120	$17.3	$155	$6,558,720
Concrete Medium Rehab	1"-3"	24-28	$219,600	$3.5	$31	$1,317,600
Concrete Light Rehab	<1"	18-22	$146,400	$2.3	$21	$878,400
Asphalt Medium Rehab	3"-8"	20-24	$307,440	$4.9	$44	$1,844,640
Asphalt Light Rehab	<3"	14-18	$204,960	$3.2	$29	$1,229,760

Pavement Service Life, Intervals, and Sequence of Improvements

SR 95 MP 148 - MP 149

Design Alternative	Typical Service Life Value	Typical Service Life Range	Average Historical Interval Value	Interval to Use in LCCA Before Reconstruction	Interval to Use in LCCA After Reconstruction
Concrete Reconstruction	32	30-34	-	-	16
Asphalt Reconstruction	28	26-30	16	-	14
Concrete Medium Rehab	26	24-28	-	13	13
Concrete Light Rehab	20	18-22	-	10	10
Asphalt Medium Rehab	22	20-24	-	11	11
Asphalt Light Rehab	16	14-18	10	8	8
None	0	0	-	-	-

Note: The typical service life values and ranges are determined based on the elevation of the roadway segment using the reference tables below. The typical service life values should be used as the intervals between improvements in the design alternatives except when historical frequency values are available based on the frequency and type of improvements in the past at this location. Historical frequency values should only be used if they are lower than the typical values and only up until reconstruction is implemented, after which typical service life values should be used.

Elevation Below 4000' (Desert Environment)		
Design Alternative	Typical Service Life Value	Typical Service Life Range
Concrete Reconstruction	32	30-34
Asphalt Reconstruction	28	26-30
Concrete Medium Rehab	26	24-28
Concrete Light Rehab	20	18-22
Asphalt Medium Rehab	22	20-24
Asphalt Light Rehab	16	14-18
None	0	0

Elevation Above 4000' (Mountain Environment)		
Design Alternative	Typical Service Life Value	Typical Service Life Range
Concrete Reconstruction	28	26-30
Asphalt Reconstruction	24	22-26
Concrete Medium Rehab	22	20-24
Concrete Light Rehab	16	14-18
Asphalt Medium Rehab	18	16-20
Asphalt Light Rehab	12	10-14
None	0	0

Assumed LCCA Sequence of Improvements Based on the Initial Design Alternative Improvement	
Concrete Reconstruction (CR):	CR, CLR, CMR, CLR, CR, CLR, CMR. . .
Asphalt Reconstruction (AR):	AR, ALR, AMR, ALR, AR, ALR, AMR. . .
Concrete Medium Rehab (CMR):	CMR, CLR, CR, CLR, CMR, CLR, CR. . .
Concrete Light Rehab (CLR):	CLR, CR, CLR, CMR, CLR, CR, CLR. . .
Asphalt Medium Rehab (AMR):	AMR, ALR, AR, ALR, AMR, ALR, AR. . .
Asphalt Light Rehab (ALR):	ALR, AR, ALR, AMR, ALR, AR, ALR. . .

Pavement Improvement Project History

SR 95 MP 148 - MP 149

Year	Project Number	Tracs No.	Direction of Improvement	Treatment Type	Improvement Description	Thickness (inches)	Beg. MP	End MP	Length (miles)
1956			NB/SB	Asphalt Light Rehab	Bituminous Treated Surface	2	147.27	153.69	6.42
1970			NB/SB	Asphalt Light Rehab	ACFC Asphaltic Concrete Friction Course	1	148	151.35	3.35
1982			NB/SB	Asphalt Light Rehab	Seal Coat - Cover Material With Emulsified Asphalt [0.3]	0.3	147.2	153.7	6.5
1987			NB/SB	Asphalt Reconstruction	Aggregate Base	12	147.19	150.3	3.11
					Asphaltic Concrete	3	147.19	150.3	3.11
					ACFC Asphaltic Concrete Friction Course	0.5	147.19	150.3	3.11
2001			NB/SB	Asphalt Light Rehab	Remove Existing Material	0.5	147.17	148.3	1.13
					ACFC With Asphaltic Rubber (AR-ACFC) [0.5 to 1.0]	0.5	147.17	148.3	1.13
2004			NB/SB	Asphalt Light Rehab	Remove Existing Material	0.5	148.3	155.1	6.8
					ACFC With Asphaltic Rubber (AR-ACFC) [0.5 to 1.0]	0.5	148.3	155.1	6.8
2011			NB	Asphalt Light Rehab	Crack Seal (Rubberized)	0	148.95	152.34	3.39
2011			NB/SB	Asphalt Medium Rehab	Remove Existing Material	3	148.29	148.32	0.03
					Asphaltic Concrete	2.5	148.29	148.32	0.03
					ACFC Asphaltic Concrete Friction Course	0.5	148.29	148.32	0.03
2012			NB/SB	Asphalt Light Rehab	Crack Seal (Rubberized)	0	144.84	148.32	3.48

Interval between Improvements in Years	
After Asphalt Light Rehab:	14
After Asphalt Light Rehab:	12
After Asphalt Light Rehab:	5
After Asphalt Reconstruction	16
After Asphalt Light Rehab:	9

Treatment Type Options	Estimated Historical Interval Value between Improvements in Years
Concrete Reconstruction	-
Asphalt Reconstruction	16
Concrete Medium Rehab	-
Concrete Light Rehab	-
Asphalt Medium Rehab	-
Asphalt Light Rehab	10

Design Alternative # 1 - Concrete Reconstruction

SR 95 MP 148 - MP 149

Enter Name of Design Alternative

Number of Years	Year	Concrete Reconstruction	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Concrete Reconstruction	$8,198,400	$7,284,172	$6,254,520
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	None	$0	$0	$0
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	None	$0	$0	$0
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	None	$0	$0	$0
20	2036	None	$0	$0	$0
21	2037	Concrete Light Rehab	$878,400	$486,349	$226,995
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	None	$0	$0	$0
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	None	$0	$0	$0
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	Concrete Medium Rehab	$1,317,600	$542,834	$173,089
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	None	$0	$0	$0
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	None	$0	$0	$0
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	Concrete Light Rehab	$878,400	$246,429	$47,884
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Concrete Light Rehab	$834,480	$227,289	$42,514
Enter Year of Last Used DA Improvement ››		2060	Remaining Service Life Cost ^^		

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$8,332,495	$6,659,975
AGENCY COST	$10,438,320	

Design Alternative # 2 - Asphalt Reconstruction

SR 95 MP 148 - MP 149

Enter Name of Design Alternative

Number of Years	Year	Asphalt Reconstruction	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Asphalt Reconstruction	$6,558,720	$5,827,338	$5,003,616
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	None	$0	$0	$0
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	None	$0	$0	$0
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	Asphalt Light Rehab	$1,229,760	$722,354	$363,842
20	2036	None	$0	$0	$0
21	2037	None	$0	$0	$0
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	None	$0	$0	$0
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	Asphalt Medium Rehab	$1,844,640	$855,350	$317,639
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	None	$0	$0	$0
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	None	$0	$0	$0
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	Asphalt Light Rehab	$1,229,760	$411,949	$100,605
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	None	$0	$0	$0
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Asphalt Light Rehab	$691,740	$188,410	$35,242
Enter Year of Last Used DA Improvement ››		2054	Remaining Service Life Cost ^^		

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$7,628,580	$5,750,460
AGENCY COST	$10,171,140	

Design Alternative # 3 - Asphalt Medium Rehab

SR 95 MP 148 - MP 149

Enter Name of Design Alternative

Number of Years	Year	Asphalt Medium Rehab Focus	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Asphalt Medium Rehab	$1,844,640	$1,638,939	$1,407,267
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	None	$0	$0	$0
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	Asphalt Light Rehab	$1,229,760	$789,336	$445,722
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	None	$0	$0	$0
20	2036	None	$0	$0	$0
21	2037	None	$0	$0	$0
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	Asphalt Reconstruction	$6,558,720	$3,323,249	$1,383,542
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	None	$0	$0	$0
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	None	$0	$0	$0
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	None	$0	$0	$0
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	Asphalt Light Rehab	$1,229,760	$411,949	$100,605
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	None	$0	$0	$0
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Asphalt Light Rehab	$691,740	$188,410	$35,242
Enter Year of Last Used DA Improvement ››		2054	Remaining Service Life Cost ^^		

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$5,975,062	$3,301,894
AGENCY COST	$10,171,140	

Design Alternative # 4 - Asphalt Light Rehab

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Enter Name of Design Alternative

Number of Years	Year	Asphalt Light Rehab Focus	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Asphalt Light Rehab	$1,229,760	$1,092,626	$938,178
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	Asphalt Reconstruction	$6,558,720	$4,600,154	$2,912,150
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	None	$0	$0	$0
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	None	$0	$0	$0
20	2036	None	$0	$0	$0
21	2037	None	$0	$0	$0
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	None	$0	$0	$0
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	Asphalt Light Rehab	$1,229,760	$570,233	$211,759
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	None	$0	$0	$0
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	Asphalt Medium Rehab	$1,844,640	$675,221	$184,869
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	None	$0	$0	$0
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	None	$0	$0	$0
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Asphalt Medium Rehab	$1,006,167	$274,052	$51,261
Enter Year of Last Used DA Improvement ››		2051	Remaining Service Life Cost ^^		

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$6,664,183	$4,195,695
AGENCY COST	$9,856,713	

	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehab Focus	Asphalt Light Rehab Focus
Net Present Value - 3%	$8,332,495	$7,628,580	$5,975,062	$6,664,183
Net Present Value - 7%	$6,659,975	$5,750,460	$3,301,894	$4,195,695
Agency Cost	$10,438,320	$10,171,140	$10,171,140	$9,856,713

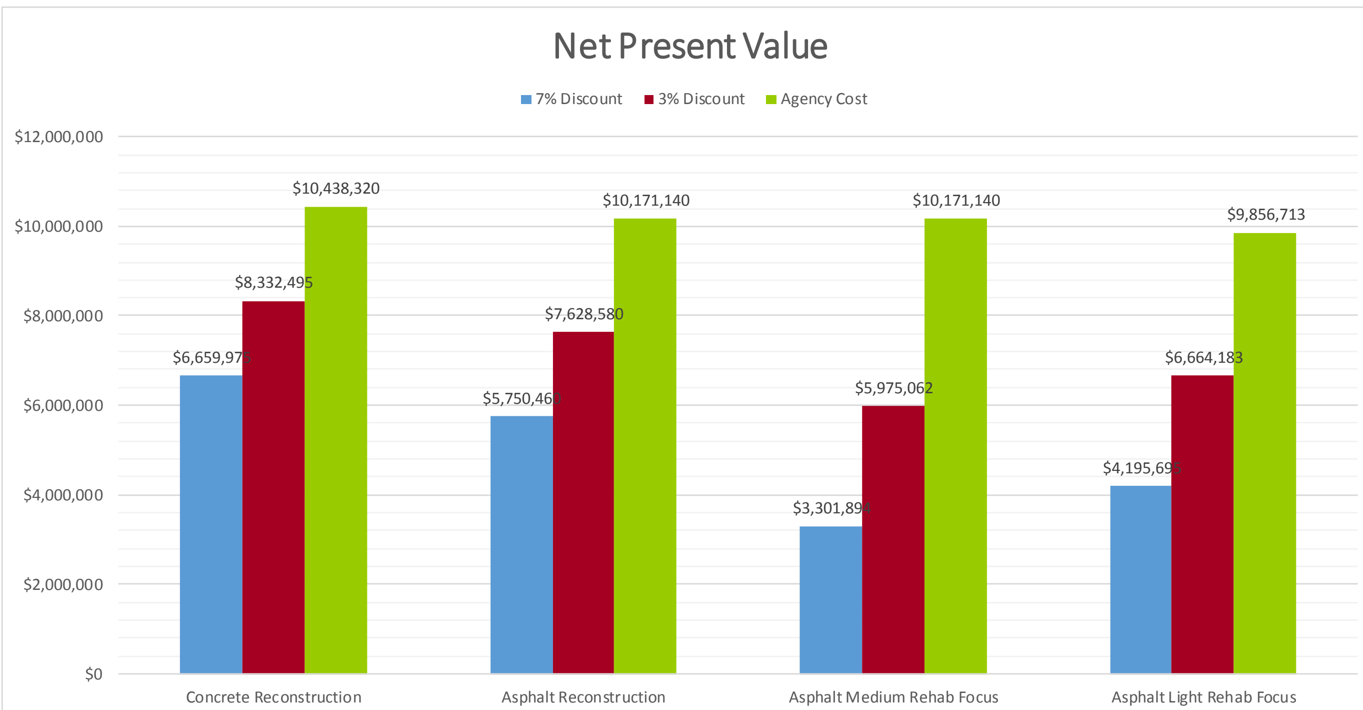
Cost Ratio at 3% Discount Rate

1.39 Ratio of Concrete Reconstruction to Lowest Cost Rehab
1.28 Ratio of Asphalt Reconstruction to Lowest Cost Rehab

Cost Ratio at 7% Discount Rate

2.02 Ratio of Concrete Reconstruction to Lowest Cost Rehab
1.74 Ratio of Asphalt Reconstruction to Lowest Cost Rehab

Note: A cost ratio < 1.15 means the Net Present Value (NPV) of reconstruction is within 15% of the NPV of the lowest cost rehab so reconstruction should likely be the initial improvement solution. A cost ratio > 1.15 means the NPV of reconstruction is more than 15% of the NPV of the lowest cost rehab so rehab should likely be the initial improvement solution.



Project Details			
Project title	SR 95 Corridor Profile Study		
Route	SR 95		
Milepost begin	181		
Milepost end	186		

Existing Roadway Characteristics			
Surface type (Asphalt or Concrete)	=	Asphalt	<<Select from Pull-down List>>
# of directions of travel (1 = one-way; 2 = two-way)	=	2	
# of lanes (in one direction)	=	2.5	
Width of typical lane (ft)	=	12.5	
Left shoulder width (ft)	=	0	
Right shoulder width (ft)	=	0	
Total roadway analysis segment length (centerline miles)	=	5	
Current year	=	2016	
Elevation (> 4,000 ft or < 4,000 ft)?	=	< 4,000 ft	<<Select from Pull-down List>>
Roadway width (ft) [each direction lanes & shoulders]	=	31.25	
Total lane-miles [total traffic direction lanes & shoulders]	=	25.0	
Total square feet [total traffic direction lanes & shoulders]	=	1,584,000	
Total square yards [total traffic direction lanes & shoulders]	=	176,000	

LCCA Parameters		
Analysis period (years)	=	40
Year of net present value	=	2017
First year of improvements	=	2021
Discount rate (%) - low	=	3%
Discount rate (%) - high	=	7%

Design Alternatives (DA)

	Characteristics		Pavement Material Cost ($)		
Treatment Type	*Pavement Thickness*	*Typical Service Life (years)*	*Lane-miles*	*Square Feet*	*Square Yards*
Concrete Reconstruction	8"-12"	30-34	$350,000	$5.5	$50
Asphalt Reconstruction	8"-12"	26-30	$280,000	$4.4	$40
Concrete Medium Rehab	1"-3"	24-28	$75,000	$1.2	$11
Concrete Light Rehab	<1"	18-22	$50,000	$0.8	$7
Asphalt Medium Rehab	3"-8"	20-24	$105,000	$1.7	$15
Asphalt Light Rehab	<3"	14-18	$70,000	$1.1	$10

Reconstruction: Other Materials Cost Factor
1.60

Rehab: Other Materials Cost Factor
1.20

Total Cost Factor (e.g., includes design, mobilization, traffic control, contingency, etc.)
2.44

			Total Unit Cost ($) [includes material costs and indirect costs]			Total Bi-Directional Cost ($)
Treatment Type	Pavement Thickness	Typical Service Life (years)	Lane-miles	Square Feet	Square Yards	Total Cost
Concrete Reconstruction	8"-12"	30-34	$1,366,400	$21.6	$194	$34,160,000
Asphalt Reconstruction	8"-12"	26-30	$1,093,120	$17.3	$155	$27,328,000
Concrete Medium Rehab	1"-3"	24-28	$219,600	$3.5	$31	$5,490,000
Concrete Light Rehab	<1"	18-22	$146,400	$2.3	$21	$3,660,000
Asphalt Medium Rehab	3"-8"	20-24	$307,440	$4.9	$44	$7,686,000
Asphalt Light Rehab	<3"	14-18	$204,960	$3.2	$29	$5,124,000

Pavement Service Life, Intervals, and Sequence of Improvements

SR 95 MP 181 - MP 186

Design Alternative	Typical Service Life Value	Typical Service Life Range	Average Historical Interval Value	Interval to Use in LCCA Before Reconstruction	Interval to Use in LCCA After Reconstruction
Concrete Reconstruction	32	30-34	-	-	16
Asphalt Reconstruction	28	26-30	-	-	14
Concrete Medium Rehab	26	24-28	-	13	13
Concrete Light Rehab	20	18-22	-	10	10
Asphalt Medium Rehab	22	20-24	13.5	11	11
Asphalt Light Rehab	16	14-18	-	8	8
None	0	0	-	-	-

Note: The typical service life values and ranges are determined based on the elevation of the roadway segment using the reference tables below. The typical service life values should be used as the intervals between improvements in the design alternatives except when historical frequency values are available based on the frequency and type of improvements in the past at this location. Historical frequency values should only be used if they are lower than the typical values and only up until reconstruction is implemented, after which typical service life values should be used.

Elevation Below 4000' (Desert Environment)		
Design Alternative	Typical Service Life Value	Typical Service Life Range
Concrete Reconstruction	32	30-34
Asphalt Reconstruction	28	26-30
Concrete Medium Rehab	26	24-28
Concrete Light Rehab	20	18-22
Asphalt Medium Rehab	22	20-24
Asphalt Light Rehab	16	14-18
None	0	0

Elevation Above 4000' (Mountain Environment)		
Design Alternative	Typical Service Life Value	Typical Service Life Range
Concrete Reconstruction	28	26-30
Asphalt Reconstruction	24	22-26
Concrete Medium Rehab	22	20-24
Concrete Light Rehab	16	14-18
Asphalt Medium Rehab	18	16-20
Asphalt Light Rehab	12	10-14
None	0	0

Assumed LCCA Sequence of Improvements Based on the Initial Design Alternative Improvement	
Concrete Reconstruction (CR):	CR, CLR, CMR, CLR, CR, CLR, CMR. . .
Asphalt Reconstruction (AR):	AR, ALR, AMR, ALR, AR, ALR, AMR. . .
Concrete Medium Rehab (CMR):	CMR, CLR, CR, CLR, CMR, CLR, CR. . .
Concrete Light Rehab (CLR):	CLR, CR, CLR, CMR, CLR, CR, CLR. . .
Asphalt Medium Rehab (AMR):	AMR, ALR, AR, ALR, AMR, ALR, AR. . .
Asphalt Light Rehab (ALR):	ALR, AR, ALR, AMR, ALR, AR, ALR. . .

Pavement Improvement Project History

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Year	Project Number	Tracs No.	Direction of Improvement	Treatment Type	Improvement Description	Thickness (inches)	Beg. MP	End MP	Length (miles)
1977			NB/SB	Asphalt Medium Rehab	Aggregate Base	4	178.42	183.85	5.43
					Bituminous Treated Surface	1	178.42	183.85	5.43
1984			NB/SB	Asphalt Medium Rehab	Asphaltic Concrete	3	179	183	4
					ACFC Asphaltic Concrete Friction Course	0.5	179	183	4
2000			NB/SB	Asphalt Medium Rehab	Remove Existing Material	2.5	182.2	182.5	0.3
					Asphaltic Concrete	2	182.2	182.5	0.3
					ACFC Asphaltic Concrete Friction Course	0.5	182.2	182.5	0.3
2004			SB	Asphalt Medium Rehab	Remove Existing Material	2.5	180.48	181.03	0.55
					Asphaltic Concrete	4.5	180.48	181.03	0.55
					ACFC With Asphaltic Rubber (AR-ACFC) [0.5 to 1.0]	0.5	180.48	181.03	0.55
2004			NB	Asphalt Medium Rehab	Asphaltic Concrete	3	180.92	181.03	0.11
					ACFC With Asphaltic Rubber (AR-ACFC) [0.5 to 1.0]	0.5	180.92	181.03	0.11
2004			NB/SB	Asphalt Medium Rehab	Remove Existing Material	2	181.03	184.06	3.03
					Asphaltic Concrete	4	181.03	184.06	3.03
					ACFC With Asphaltic Rubber (AR-ACFC) [0.5 to 1.0]	0.5	181.03	184.06	3.03

Interval between Improvements in Years
After Asphalt Medium Rehab: 20
After Asphalt Medium Rehab: 7
After Asphalt Medium Rehab:
After Asphalt Medium Rehab:

Treatment Type Options	Estimated Historical Interval Value between Improvements in Years
Concrete Reconstruction	-
Asphalt Reconstruction	-
Concrete Medium Rehab	-
Concrete Light Rehab	-
Asphalt Medium Rehab	14
Asphalt Light Rehab	-

Design Alternative # 1 - Concrete Reconstruction

SR 95 MP 181 - MP 186

Enter Name of Design Alternative

Number of Years	Year	Concrete Reconstruction	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Concrete Reconstruction	$34,160,000	$30,350,718	$26,060,500
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	None	$0	$0	$0
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	None	$0	$0	$0
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	None	$0	$0	$0
20	2036	None	$0	$0	$0
21	2037	Concrete Light Rehab	$3,660,000	$2,026,453	$945,814
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	None	$0	$0	$0
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	None	$0	$0	$0
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	Concrete Medium Rehab	$5,490,000	$2,261,807	$721,205
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	None	$0	$0	$0
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	None	$0	$0	$0
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	Concrete Light Rehab	$3,660,000	$1,026,787	$199,516
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Concrete Light Rehab	$3,477,000	$947,037	$177,141
Enter Year of Last Used DA Improvement ››		2060	Remaining Service Life Cost ^^		

		Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE		$34,718,729	$27,749,895
AGENCY COST		$43,493,000	

Design Alternative # 2 - Asphalt Reconstruction

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Enter Name of Design Alternative

Number of Years	Year	Asphalt Reconstruction	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Asphalt Reconstruction	$27,328,000	$24,280,574	$20,848,400
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	None	$0	$0	$0
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	None	$0	$0	$0
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	Asphalt Light Rehab	$5,124,000	$3,009,810	$1,516,007
20	2036	None	$0	$0	$0
21	2037	None	$0	$0	$0
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	None	$0	$0	$0
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	Asphalt Medium Rehab	$7,686,000	$3,563,958	$1,323,495
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	None	$0	$0	$0
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	None	$0	$0	$0
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	Asphalt Light Rehab	$5,124,000	$1,716,453	$419,188
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	None	$0	$0	$0
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Asphalt Light Rehab	$2,882,250	$785,044	$146,840
Enter Year of Last Used DA Improvement ››		2054	Remaining Service Life Cost ^^		

		Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE		$31,785,751	$23,960,250
AGENCY COST		$42,379,750	

Design Alternative # 3 - Asphalt Medium Rehab

SR 95 MP 181 - MP 186

Enter Name of Design Alternative

Number of Years	Year	Asphalt Medium Rehab Focus	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Asphalt Medium Rehab	$7,686,000	$6,828,911	$5,863,613
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	None	$0	$0	$0
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	Asphalt Light Rehab	$5,124,000	$3,288,901	$1,857,173
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	None	$0	$0	$0
20	2036	None	$0	$0	$0
21	2037	None	$0	$0	$0
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	Asphalt Reconstruction	$27,328,000	$13,846,872	$5,764,756
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	None	$0	$0	$0
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	None	$0	$0	$0
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	None	$0	$0	$0
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	Asphalt Light Rehab	$5,124,000	$1,716,453	$419,188
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	None	$0	$0	$0
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Asphalt Light Rehab	$2,882,250	$785,044	$146,840
Enter Year of Last Used DA Improvement ››		2054	Remaining Service Life Cost ^^		

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$24,896,093	$13,757,891
AGENCY COST	$42,379,750	

Design Alternative # 4 - Asphalt Light Rehab

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Enter Name of Design Alternative

Number of Years	Year	Asphalt Light Rehab Focus	Agency Cost ($)	Net Present Value @ 3%	Net Present Value @ 7%
0	2016	None	$0	$0	$0
1	2017	None	$0	$0	$0
2	2018	None	$0	$0	$0
3	2019	None	$0	$0	$0
4	2020	None	$0	$0	$0
5	2021	Asphalt Light Rehab	$5,124,000	$4,552,608	$3,909,075
6	2022	None	$0	$0	$0
7	2023	None	$0	$0	$0
8	2024	None	$0	$0	$0
9	2025	None	$0	$0	$0
10	2026	None	$0	$0	$0
11	2027	None	$0	$0	$0
12	2028	None	$0	$0	$0
13	2029	Asphalt Reconstruction	$27,328,000	$19,167,309	$12,133,959
14	2030	None	$0	$0	$0
15	2031	None	$0	$0	$0
16	2032	None	$0	$0	$0
17	2033	None	$0	$0	$0
18	2034	None	$0	$0	$0
19	2035	None	$0	$0	$0
20	2036	None	$0	$0	$0
21	2037	None	$0	$0	$0
22	2038	None	$0	$0	$0
23	2039	None	$0	$0	$0
24	2040	None	$0	$0	$0
25	2041	None	$0	$0	$0
26	2042	None	$0	$0	$0
27	2043	Asphalt Light Rehab	$5,124,000	$2,375,972	$882,330
28	2044	None	$0	$0	$0
29	2045	None	$0	$0	$0
30	2046	None	$0	$0	$0
31	2047	None	$0	$0	$0
32	2048	None	$0	$0	$0
33	2049	None	$0	$0	$0
34	2050	None	$0	$0	$0
35	2051	Asphalt Medium Rehab	$7,686,000	$2,813,421	$770,286
36	2052	None	$0	$0	$0
37	2053	None	$0	$0	$0
38	2054	None	$0	$0	$0
39	2055	None	$0	$0	$0
40	2056	None	$0	$0	$0
41	2057	None	$0	$0	$0
42	2058	None	$0	$0	$0
43	2059	None	$0	$0	$0
44	2060	None	$0	$0	$0
45	2061	None	$0	$0	$0
Pick Last Used DA treatment type to calculate Remaining Service Life ››		Asphalt Medium Rehab	$4,192,364	$1,141,882	$213,586
Enter Year of Last Used DA Improvement ››		2051	Remaining Service Life Cost ^^		

	Net Present Value ($) @ 3%	Net Present Value ($) @ 7%
NET PRESENT VALUE	$27,767,428	$17,482,064
AGENCY COST	$41,069,636	

Summary of LCCA Results

SR 95 MP 181 - MP 186

	Concrete Reconstruction	Asphalt Reconstruction	Asphalt Medium Rehab Focus	Asphalt Light Rehab Focus
Net Present Value - 3%	$34,718,729	$31,785,751	$24,896,093	$27,767,428
Net Present Value - 7%	$27,749,895	$23,960,250	$13,757,891	$17,482,064
Agency Cost	$43,493,000	$42,379,750	$42,379,750	$41,069,636

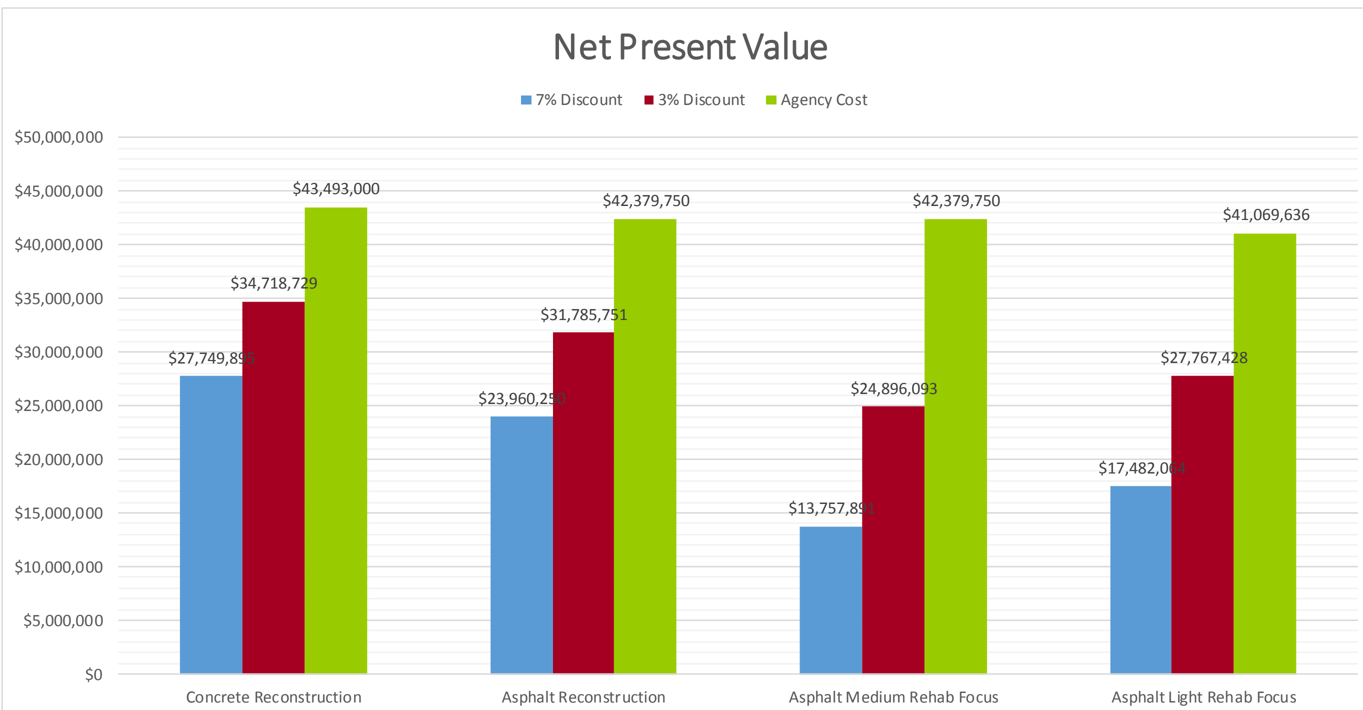
Cost Ratio at 3% Discount Rate

1.39 Ratio of Concrete Reconstruction to Lowest Cost Rehab
1.28 Ratio of Asphalt Reconstruction to Lowest Cost Rehab

Cost Ratio at 7% Discount Rate

2.02 Ratio of Concrete Reconstruction to Lowest Cost Rehab
1.74 Ratio of Asphalt Reconstruction to Lowest Cost Rehab

Note: A cost ratio < 1.15 means the Net Present Value (NPV) of reconstruction is within 15% of the NPV of the lowest cost rehab so reconstruction should likely be the initial improvement solution. A cost ratio > 1.15 means the NPV of reconstruction is more than 15% of the NPV of the lowest cost rehab so rehab should likely be the initial improvement solution.



APPENDIX C: CRASH MODIFICATION FACTORS AND FACTORED CONSTRUCTION UNIT COSTS

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF for CPS	CMF NOTES
REHABILITATION							
Rehabilitate Pavement (AC)	$276,500	Mile	2.20	$610,000	Mill and replace 1"-3" AC pvmt; accounts for 38' width; for one direction of travel on two lane roadway; includes pavement, striping, delineators, RPMs, rumble strips	0.70	Combination of rehabilitate pavement (0.92), striping, delineators, RPMs (0.77 for combination), and rumble strips (0.89) = 0.70
Rehabilitate Bridge	$65	SF	2.20	$140	Based on deck area; bridge only - no other costs included	0.95	Assumed - should have a minor effect on crashes at the bridge
GEOMETRIC IMPROVEMENT							
Re-profile Roadway	$974,500	Mile	2.20	$2,140,000	Includes excavation of approximately 3", pavement replacement (AC), striping, delineators, RPMs, rumble strips, for one direction of travel of 2-lane roadway (38' width)	0.70	Assumed - this is similar to rehab pavement. This solution is intended to address vertical clearance at bridge, not profile issue.
Realign Roadway	$2,960,000	Mile	2.20	$6,510,000	All costs per direction except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.50	Based on CalTrans and NC DOT
Improve Skid Resistance	$675,000	Mile	2.20	$1,490,000	Average cost of pvmt replacement and variable depth paving to increase super-elevation; for one direction of travel on two lane roadway; includes pavement, striping, delineators, RPMs, rumble strips	0.66	Combination of avg of 5 values from clearinghouse (0.77) and calculated value from HSM (0.87) for skid resistance; striping, delineators, RPMs (0.77 for combination), and rumble strips (0.89) = 0.66
INFRASTRUCTURE IMPROVEMENT							
Reconstruct to Urban Section	$1,000,000	Mile	2.20	$2,200,000	Includes widening by 16' total (AC = 12'+2'+2') to provide median, curb & gutter along both side of roadway, single curb for median, striping (doesn't include widening for additional travel lane).	0.88	From HSM
Construct Auxiliary Lanes (AC)	$914,000	Mile	2.20	$2,011,000	For addition of aux lane (AC) in one direction of travel; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.78	Average of 4 values from clearinghouse
Construct Climbing Lane (High)	$3,000,000	Mile	2.20	$6,600,000	In one direction; all costs except bridges; applicable to areas with large fills and cuts, retaining walls, rock blasting, steep slopes on both sides of road	0.75	From HSM
Construct Climbing Lane (Medium)	$2,250,000	Mile	2.20	$4,950,000	In one direction; all costs except bridges; applicable to areas with medium or large fills and cuts, retaining walls, rock blasting, steep slopes on one side of road	0.75	From HSM
Construct Climbing Lane (Low)	$1,500,000	Mile	2.20	$3,300,000	In one direction; all costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.75	From HSM
Construct Passing Lane	$1,500,000	Mile	2.20	$3,300,000	In one direction; all costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.63	Average of 3 values from clearinghouse
Construct Reversible Lane (Low)	$2,400,000	Lane-Mile	2.20	$5,280,000	All costs except bridges; applicable to areas with small or moderate fills and cuts, minimal retaining walls	0.73 for uphill and 0.88 for downhill	Based on proposed conditions on I-17 with 2 reversible lanes and a concrete barrier
Construct Reversible Lane (High)	$4,800,000	Lane-Mile	2.20	$10,560,000	All costs except bridges; applicable to areas with large fills and cuts, retaining walls, rock blasting, mountainous terrain	0.73 for uphill and 0.88 for downhill	Based on proposed conditions on I-17 with 2 reversible lanes and a concrete barrier
Construct Entry/Exit Ramp	$730,000	Each	2.20	$1,610,000	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, typical earthwork & drainage; does not include any major structures or improvements on crossroad	1.09	Average of 16 values on clearinghouse; for adding a ramp not reconstructing
Construct Turn Lanes	$170,000	Each	2.20	$374,000	Includes 14' roadway widening (AC) for one additional turn lane (250' long) on one leg of an intersection; includes AC	0.81	Average of 7 values from HSM

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF for CPS	CMF NOTES
					pavement, curb & gutter, sidewalk, ramps, striping, and minor signal modifications		
Modify Entry/Exit Ramp	$445,000	Each	2.20	$979,000	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, minor earthwork, & drainage; For converting existing ramp to parallel-type configuration	0.21	Average of 4 values from clearinghouse (for exit ramps) and equation from HSM (for entrance ramp)
Widen & Modify Entry/Exit Ramp	$619,000	Each	2.20	$1,361,800	Cost per ramp; includes pavement, striping, signing, RPMs, lighting, minor earthwork, & drainage; For converting 1-lane ramp to 2-lane ramp and converting to parallel-type ramp	0.21	Will be same as "Modify Ramp"
Replace Pavement (AC) (with overexcavation)	$1,446,500	Mile	2.20	$3,180,000	Accounts for 38' width; for one direction of travel on two lane roadway; includes pavement, overexcavation, striping, delineators, RPMs, rumble strips	0.70	Same as rehab
Replace Pavement (PCCP) (with overexcavation)	$1,736,500	Mile	2.20	$3,820,000	Accounts for 38' width; for one direction of travel on two lane roadway; includes pavement, overexcavation, striping, delineators, RPMs, rumble strips	0.70	Same as rehab
Replace Bridge	$125	SF	2.20	$280	Based on deck area; bridge only - no other costs included	0.95	Assumed - should have a minor effect on crashes at the bridge
Widen Bridge	$175	SF	2.20	$390	Based on deck area; bridge only - no other costs included	0.90	Assumed - should have a minor effect on crashes at the bridge
Install Pedestrian Bridge	$135	SF	2.20	$300	Includes cost to construct bridge based on linear feet of the bridge. This costs includes and assumes ramps and sidewalks leading to the structure.	0.1 (ped only)	Assumed direct access on both sides of structure
Implement Automated Bridge De-icing	$115	SF	2.20	$250	Includes cost to replace bridge deck and install system	0.72 (snow/ice)	Average of 3 values on clearinghouse for snow/ice
Install Wildlife Crossing Under Roadway	$650,000	Each	2.20	$1,430,000	Includes cost of structure for wildlife crossing under roadway	0.25 (wildlife)	Assumed
Install Wildlife Crossing Over Roadway	$1,140,000	Each	2.20	$2,508,000	Includes cost of structure for wildlife crossing over roadway	0.25 (wildlife)	Assumed
Construct Drainage Structure - Minor	$280,000	Each	2.20	$616,000	Includes 3-36" pipes and roadway reconstruction (approx. 1,000 ft) to install pipes	0.70	Same as rehab
Construct Drainage Structure - Intermediate	$540,000	Each	2.20	$1,188,000	Includes 5 barrel 8'x6' RCBC and roadway reconstruction (approx. 1,000 ft) to install RCBC	0.70	Same as rehab
Construct Drainage Structure - Major	$8,000	LF	2.20	$17,600	Includes bridge that is 40' wide and reconstruction of approx. 500' on each approach	0.70	Same as rehab
Install Center Turn Lane	$450,000	Mile	2.20	$990,000	Assumes widening (AC) of undivided facility to provide directional left-turn lane or two-way left-turn lane with associated transitions, signage and markings and standard shoulders; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.86	Average of 2 values from CMF Clearinghouse
OPERATIONAL IMPROVEMENT							
Implement Variable Speed Limits (Wireless, Overhead)	$718,900	Mile	2.20	$1,580,000	In one direction; includes 2 signs per mile (foundations and structures), wireless communication, detectors	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Ground-mount)	$169,700	Mile	2.20	$373,300	In one direction; includes 2 signs per mile (foundations and posts), wireless communication, detectors	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Solar, Overhead)	$502,300	Mile	2.20	$1,110,000	In one direction; includes 2 signs per mile (foundations and structures), wireless communication, detectors, solar power	0.92	From 1 value from clearinghouse
Implement Variable Speed Limits (Wireless, Solar, Ground-mount)	$88,400	Mile	2.20	$194,500	In one direction; includes 2 signs per mile (foundations and posts), wireless communication, detectors, solar power	0.92	From 1 value from clearinghouse

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF for CPS	CMF NOTES
Implement Ramp Metering (Low)	$25,000	Each	2.20	$55,000	For each entry ramp location; urban area with existing ITS backbone infrastructure; includes signals, poles, timer, pull boxes, etc.	0.64	From 1 value from clearinghouse
Implement Ramp Metering (High)	$150,000	Mile	2.20	$330,000	Area without existing ITS backbone infrastructure; in addition to ramp meters, also includes conduit, fiber optic lines, and power	0.64	From 1 value from clearinghouse
Implement Shoulder Running (ATM components only)	$718,900	Mile	2.20	$1,581,600	In one direction; includes overhead signs, wireless communication, etc., but does not include shoulder widening	0.78	Combination of adding climbing lane & reducing shoulder when active, and increasing shoulder when not active
Implement Shoulder Running (ATM and shoulder widening)	$1,920,000	Mile	2.20	$4,224,000	In one direction; includes overhead signs, communication backbone, etc., and shoulder widening with pavement striping, striping, etc. to widen by 10'	0.78	Combination of adding climbing lane & reducing shoulder when active, and increasing shoulder when not active
Implement Shoulder Running (ATM and shoulder widening in mountainous terrain)	$3,120,000	Mile	2.20	$6,864,000	In one direction; includes overhead signs, communication backbone, etc., and shoulder widening in mountainous terrain with pavement striping, striping, etc. to widen by 10'	0.78	Combination of adding climbing lane & reducing shoulder when active, and increasing shoulder when not active
Implement Signal Coordination	$140,000	Mile	2.20	$308,000	Includes conduit, conductors, and controllers for 4 intersections that span a total of approximately 2 miles	0.90	Assumed
Implement Left-turn Phasing	$7,500	Each	2.20	$16,500	Includes four new signal heads (two in each direction) and associated conductors for one intersection	0.88 (protected) 0.98 (perm/protected or protected/perm)	From HSM; CMF = 0.94 for each protected approach and 0.99 for each permitted/protected or protected/permitted approach. CMFs of different approaches should be multiplied together
ROADSIDE DESIGN							
Install Guardrail	$130,000	Mile	2.20	$286,000	One side of road	0.62 (ROR)	0.62 is average of 2 values from clearinghouse
Install Cable Barrier	$80,000	Mile	2.20	$176,000	In median	0.81	0.81 is average of 5 values from clearinghouse
Widen Shoulder (AC)	$256,000	Mile	2.20	$563,000	Assumes 10' of existing shoulder (combined left and right), includes widening shoulder by a total of 4'; new pavement for 4' width and mill and replace existing 10' width; includes pavement, minor earthwork, striping edge lines, RPMs, high-visibility delineators, and rumble strips	0.68 (1-4') 0.64 (>= 4')	0.86 is average of 5 values from clearing house for widening shoulder 1-4'. 0.76 is calculated from HSM for widening shoulder >= 4'. (Cost needs to be updated if dimension of existing and widened shoulder differ from Description.)
Rehabilitate Shoulder (AC)	$113,000	Mile	2.20	$249,000	One direction of travel (14' total shoulder width-4' left and 10' right); includes paving (mill and replace), striping, high-visibility delineators, RPMs, and rumble strips for both shoulders	0.72	0.98 is average of 34 values on clearinghouse for shoulder rehab/replace; include striping, delineators, RPMs (0.77 combined CMF), and rumble strips (0.89). (Cost needs to be updated if dimension of existing shoulder differs from Description.)
Replace Shoulder (AC)	$364,000	Mile	2.20	$801,000	One direction of travel (14' total shoulder width-4' left and 10' right); includes paving (full reconstruction), striping, high-visibility delineators, RPMs, and rumble strips for both shoulders	0.72	0.98 is average of 34 values on clearinghouse for shoulder rehab/replace; include striping, delineators, RPMs (0.77 combined CMF), and rumble strips (0.89). (Cost needs to be updated if dimension of existing shoulder differs from Description.)
Install Rumble Strip	$5,500	Mile	2.20	$12,000	Both edges - one direction of travel; includes only rumble strip; no shoulder rehab or paving or striping	0.89	Average of 75 values on clearinghouse and consistent with HSM
Install Safety Edge	$80,000	Mile	2.20	$176,000		0.87	Average of 12 values on clearinghouse
Install Wildlife Fencing	$340,000	Mile	2.20	$748,000	Fencing only plus jump outs for 1 mile (both directions)	0.50 (wildlife)	Assumed
Remove Tree/Vegetation	$200,000	Mile	2.20	$440,000		0.62	CMF Clearinghouse for removal of fixed object
Install Centerline Rumble Strip	$2,800	Mile	2.20	$6,000	Includes rumble strip only; no pavement rehab or striping	0.85	From HSM

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF for CPS	CMF NOTES
Install Access Barrier Fence	$15	LF	2.20	$33	8' fencing along residential section of roadway	0.1 (pedestrian only)	Equal to pedestrian overpass
Install Rock-Fall Mitigation - Wire Mesh	$1,320,000	Mile	2.20	$2,904,000	Includes wire mesh and rock stabilization (one direction)	0.75 (debris)	Assumed
Install Rock-Fall Mitigation - Containment Fence & Barrier	$2,112,000	Mile	2.20	$4,646,000	Includes containment fencing, concrete barrier, and rock stabilization (one direction)	0.75 (debris)	Assumed
Install Raised Concrete Barrier in Median	$650,000	Mile	2.20	$1,430,000	Includes concrete barrier with associated striping and reflective markings; excludes lighting in barrier (one direction)	0.90 (Cross-median and head on crashes eliminated completely)	All cross median and head-on fatal or incapacitating injury crashes are eliminated completely; all remaining crashes have 0.90 applied
INTERSECTION IMPROVEMENTS							
Construct Traffic Signal	$150,000	Each	2.20	$330,000	4-legged intersection; includes poles, foundations, conduit, controller, heads, luminaires, mast arms, etc.	0.95	From HSM
Improve Signal Visibility	$35,000	Each	2.20	$77,000	4-legged intersection; signal head size upgrade, installation of new back-plates, and installation of additional signal heads on new poles.	0.85	Average of 7 values from clearinghouse.
Install Raised Median	$360,000	Mile	2.20	$792,000	Includes removal of 14' wide pavement and construction of curb & gutter; does not include cost to widen roadway to accommodate the median; if the roadway needs to be widened, include cost from New General Purpose Lane	0.83	Average from HSM
Install Transverse Rumble Strip/Pavement Markings	$3,000	Each	2.20	$7,000	Includes pedestrian markings and rumble strips only across a 30' wide travel way; no pavement rehab or other striping	0.95	Average of 17 values from clearinghouse.
Construct Single-Lane Roundabout	$1,500,000	Each	2.20	$3,300,000	Removal of signal at 4-legged intersection; realignment of each leg for approx. 800 feet including paving, curbs, sidewalk, striping, lighting, signing	0.22	From HSM
Construct Double-Lane Roundabout	$1,800,000	Each	2.20	$3,960,000	Removal of signal at 4-legged intersection; realignment of each leg for approx. 800 feet including paving, curbs, sidewalk, striping, lighting, signing	0.40	From HSM
ROADWAY DELINEATION							
Install High-Visibility Edge Line Striping	$10,800	Mile	2.20	$23,800	2 edge lines and lane line - one direction of travel	0.77	Average of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs. (If implemented separately, CMF will be higher.)
Install High-Visibility Delineators	$6,500	Mile	2.20	$14,300	Both edges - one direction of travel		Average of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs. (If implemented separately, CMF will be higher.)
Install Raised Pavement Markers	$2,000	Mile	2.20	$4,400	Both edges - one direction of travel		Average of 3 values from clearinghouse. Assumes package of striping, delineators, and RPMs. (If implemented separately, CMF will be higher.)
Install In-Lane Route Markings	$6,000	Each	2.20	$13,200	Installation of a series of three in-lane route markings in one lane	0.95	Assumed
IMPROVED VISIBILITY							

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF for CPS	CMF NOTES
Cut Side Slopes	$80	LF	2.20	$200	For small grading to correct sight distance issues; not major grading	0.85	Intent of this solution is to improve sight distance. Most CMF's are associated with vehicles traveling on slope. Recommended CMF is based on FDOT and NCDOT but is more conservative.
Install Lighting (connect to existing power)	$270,000	Mile	2.20	$594,000	One side of road only; offset lighting, not high-mast; does not include power supply; includes poles, luminaire, pull boxes, conduit, conductor	0.75 (night)	Average of 3 values on clearinghouse & consistent with HSM
Install Lighting (solar powered LED)	$10,000	Pole	2.20	$22,000	Offset lighting, not high-mast; solar power LED; includes poles, luminaire, solar panel	0.75 (night)	Average of 3 values on clearinghouse & consistent with HSM
DRIVER INFORMATION/WARNING							
Install Dynamic Message Sign (DMS)	$250,000	Each	2.20	$550,000	Includes sign, overhead structure, and foundations; wireless communication; does not include power supply	1.00	Not expected to reduce crashes
Install Dynamic Weather Warning Beacons	$40,000	Each	2.20	$88,000	Assumes solar operation and wireless communication or connection to existing power and communication; ground mounted; includes posts, foundations, solar panel, and dynamic sign	0.65 (weather related)	Average of 3 values from HSM for dynamic/changeable warning signs
Install Speed Feedback Signs	$25,000	Each	2.20	$55,000	Assumes solar operation and no communication; ground mounted; includes regulatory sign, posts, foundations, solar panel, and dynamic sign	0.54	From HSM
Install Chevrons	$18,400	Mile	2.20	$40,500	On one side of road - includes signs, posts, and foundations	0.79	Average of 11 values on clearinghouse
Install Warning Signs	$2,500	Each	2.20	$5,500	Includes 2 signs, posts, and foundations	0.83	Average of 4 clearinghouse values
Install Wildlife Warning System	$162,000	Each	2.20	$356,400	Includes wildlife detection system, flashing warning signs (assumes solar power), advance signing, CCTV (solar and wireless), and fencing for approximately 2 miles in each direction	0.50 (wildlife)	Assumed
Install Warning Sign with Beacons	$15,000	Each	2.20	$33,000	In both directions; includes warning sign, post, and foundation, and flashing beacons (assumes solar power) at one location	0.75	FHWA Desktop Reference for Installing Flashing Beacons as Advance Warning = 0.75
Install Larger Stop Sign with Beacons	$10,000	Each	2.20	$22,000	In one direction; includes large stop sign, post, and foundation, and flashing beacons (assumes solar power) at one location	0.85/0.81	Use 0.85 for adding beacons to an existing sign; 0.81 for installing a larger sign with flashing beacons
DATA COLLECTION							
Install Road Weather Information System (RWIS)	$60,000	Each	2.20	$132,000	Assumes wireless communication and solar power, or connection to existing power and communications	1.00	Not expected to reduce crashes
Install Closed Circuit Television (CCTV) Camera	$25,000	Each	2.20	$55,000	Assumes connection to existing ITS backbone or wireless communication; does not include fiber-optic backbone infrastructure; includes pole, camera, etc.	1.00	Not expected to reduce crashes
Install Vehicle Detection Stations	$15,000	Each	2.20	$33,000	Assumes wireless communication and solar power, or connection to existing power and communications	1.00	Not expected to reduce crashes
Install Flood Sensors (Activation)	$15,000	Each	2.20	$33,000	Sensors with activation cabinet to alert through texting (agency)	1.00	Not expected to reduce crashes
Install Flood Sensors (Gates)	$100,000	Each	2.20	$220,000	Sensors with activation cabinet to alert through texting (agency) and beacons (public) plus gates	1.00	Not expected to reduce crashes
WIDEN CORRIDOR							
Construct New General Purpose Lane (PCCP)	$1,740,000	Mile	2.20	$3,830,000	For addition of 1 GP lane (PCCP) in one direction; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.90	North Carolina DOT uses 0.90 and Florida DOT uses 0.87

SOLUTION	CONSTRUCTION UNIT COST	UNIT	FACTOR^	FACTORED CONSTRUCTION UNIT COST	DESCRIPTION	CMF for CPS	CMF NOTES
Construct New General Purpose Lane (AC)	$1,200,000	Mile	2.20	$2,640,000	For addition of 1 GP lane (AC) in one direction; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.90	North Carolina DOT uses 0.90 and Florida DOT uses 0.88
Convert a 2-lane undivided highway to a 5-lane highway	$1,576,000	Mile	2.20	$3,467,200	For expanding a 2-lane undivided highway to a 5-lane highway (4 through lanes with TWLTL), includes standard shoulder widths but no curb, gutter, or sidewalks	0.70	Assumed to be slightly lower than converting from a 4-lane to a 5-lane highway
Convert a 4-lane undivided highway to a 5-lane highway	$1,053,000	Mile	2.20	$2,316,600	For expanding a 4-lane undivided highway to a 5-lane highway (4 through lanes with TWLTL), includes standard shoulder widths but no curb, gutter, or sidewalk	0.75	From FHWA Desktop Reference for CRFs, CMF Clearinghouse, and SR 87 CPS comparison
Construct 4-lane Divided Highway (Using Existing 2-lane Road for one direction)	$3,000,000	Mile	2.20	$6,600,000	In both directions; one direction uses existing 2-lane road; other direction assumes addition of 2 new lanes (AC) with standard shoulders; includes all costs except bridges	0.67	Assumed
Construct 4-lane Divided Highway (No Use of Existing Roads)	$6,000,000	Mile	2.20	$13,200,000	In both directions; assumes addition of 2 new lanes (AC) with standard shoulders in each direction; includes all costs except bridges	0.67	Assumed
Construct Bridge over At-Grade Railroad Crossing	$10,000,000	Each	2.20	$22,000,000	Assumes bridge width of 4 lanes (AC) with standard shoulders; includes abutments and bridge approaches; assumes vertical clearance of 23'4" + 6'8" superstructure	0.72 (All train-related crashes eliminated)	Removes all train-related crashes at at-grade crossing; all other crashes CMF = 0.72
Construct Underpass at At-Grade Railroad Crossing	$15,000,000	Each	2.20	$33,000,000	Assumes underpass width of 4 lanes (AC) with standard shoulders; includes railroad bridge with abutments and underpass approaches; assumes vertical clearance of 16'6" + 6'6" superstructure	0.72 (All train-related crashes eliminated)	Removes all train-related crashes at at-grade crossing; all other crashes CMF = 0.72
Construct High-Occupancy Vehicle (HOV) Lane	$900,000	Mile	2.20	$1,980,000	For addition of 1 HOV lane (AC) in one direction with associated signage and markings; includes all costs except bridges; for generally at-grade facility with minimal walls and no major drainage improvements	0.95	Similar to general purpose lane
ALTERNATE ROUTE							
Construct Frontage Roads	$2,400,000	Mile	2.20	$5,280,000	For 2-lane AC frontage road; includes all costs except bridges; for generally at-grade facility with minimal walls	0.90	Assumed - similar to new general purpose lane
Construct 2-lane Undivided Highway	$3,000,000	Mile	2.20	$6,600,000	In both directions; assumes addition of 2 new lanes (AC) with standard shoulders in each direction; includes all costs except bridges	0.90	Assuming new alignment for a bypass

^ Factor accounts for traffic control, erosion control, construction surveying and quality control, mobilization, construction engineering, contingencies, indirect cost allocation, and miscellaneous work

APPENDIX D: PERFORMANCE AREA RISK FACTORS

Pavement Performance Area

- Mainline Daily Traffic Volume
- Mainline Daily Truck Volume
- Elevation
- Interrupted Flow

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000’
0-5	4000’- 9000’
5	> 9000’

Mainline Daily Traffic Volume

Exponential equation; score = $5-(5*e^{(ADT*-0.000039)})$

Score	Condition
0	< 6,000
0-5	6,000 – 160,000
5	>160,000

Mainline Daily Truck Volume

Exponential equation; score = $5-(5*e^{(ADT*-0.00025)})$

Score	Condition
0	<900
0-5	900-25,000
5	>25,000

Interrupted Flow

Score	Condition
0	Not interrupted flow
5	Interrupted Flow

Bridge Performance Area

- Mainline Daily Traffic Volume
- Detour Length
- Elevation
- Scour Critical Rating
- Carries Mainline Traffic
- Vertical Clearance

Mainline Daily Traffic Volume

Exponential equation; score = $5-(5*e^{(ADT*-0.000039)})$

Score	Condition
0	<6,000
0-5	6,000-160,000
5	>160,000

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000’
0-5	4000’- 9000’
5	> 9000’

Carries Mainline

Score	Condition
0	Does not carry mainline traffic
5	Carries mainline traffic

Detour Scale

Divides detour length by 10 and multiplies by 2.5

Score	Condition
0	0 miles
0-5	0-20 miles
5	> 20 miles

Scour

Variance below 8

Score	Condition
0	Rating > 8
0-5	Rating 8 - 3
5	Rating < 3

Vertical Clearance

Variance below 16’ x 2.5; (16 –Clearance) x 2.5

Score	Condition
0	>16’
0-5	16’-14’
5	<14’

Mobility Performance Area

- Mainline VMT
- Detour Length
- Buffer Index (PTI-TTI)
- Shoulder Width

Mainline VMT

Exponential equation; score = 5-(5*e$^{(ADT*-0.0000139)}$)

Score	Condition
0	<16,000
0-5	16,000-400,000
5	>400,000

Buffer Index

Buffer Index x 10

Score	Condition
0	Buffer Index = 0.00
0-5	Buffer Index 0.00-0.50
5	Buffer Index > 0.50

Detour Length

Score	Condition
0	Detour < 10 miles
5	Detour > 10 miles

Shoulder Width

Variance below 10', if only 1 lane in each direction

Score	Condition
0	10' or above or >1 lane in each direction
0-5	10'-5' and 1 lane in each direction
5	5' or less and 1 lane in each direction

Safety Performance Area

- Mainline Daily Traffic Volume
- Vertical Grade
- Shoulder width (Right)
- Elevation
- Interrupted Flow

Mainline Daily Traffic Volume

Exponential equation; score = 5-(5*e$^{(ADT*-0.000039)}$)

Score	Condition
0	<6,000
0-5	6,000-160,000
5	>160,000

Interrupted Flow

Score	Condition
0	Not interrupted flow
5	Interrupted Flow

Elevation

Variance above 4000' divided by 1000; (Elev-4000)/1000

Score	Condition
0	< 4000'
0-5	4000'- 9000'
5	> 9000'

Shoulder Right side)

Variance below 10'

Score	Condition
0	10' or above
0-5	10' - 5'
5	5' or less

Grade

Variance above 3% x 1.5

Score	Condition
0	< 3%
0-5	3% - 6.33%
5	>6.33%

Freight Performance Area

- Mainline Daily Truck Volume
- Detour Length
- Truck Buffer Index (TPTI-TTTI)
- Shoulder Width

Mainline Daily Truck Volume

Exponential equation; score = 5-(5*e$^{(ADT*-0.00025)}$)

Score	Condition
0	<900
0-5	900-25,000
5	>25,000

Detour Length

Score	Condition
0	Detour < 10 miles
5	Detour > 10 miles

Truck Buffer Index

Truck Buffer Index x 10

Score	Condition
0	Buffer Index = 0.00
0-5	Buffer Index 0.00-0.50
5	Buffer Index > 0.50

Shoulder Width

Variance below 10', if only 1 lane in each direction

Score	Condition
0	10' or above or >1 lane in each direction
0-5	10'-5' and 1 lane in each direction
5	5' or less and 1 lane in each direction

Solution Number	Mainline Traffic Vol (vpd) (2-way)	Solution Length (miles)	Bridge Detour Length (miles) (N19)	Elevation (ft)	Scour Critical Rating (0-9)	Carries Mainline Traffic (Y/N)	Bridge Vert. Clear (ft)	Mainline Truck Vol (vpd) (2-way)	Detour Length > 10 miles (Y/N)	Truck Buffer Index	Non-Truck Buffer Index	Grade (%)	Interrupted Flow (Y/N)	Outside/ Right Shoulder Width (ft)	1-lane each direction
1	9,480	5		158				703	Y	2.34	2.315254	0.1	Y	6.22	N
2	7,782	4		185				612	Y	0.56	0.65479	0.2	N	6.1	Y
3	7,782	3		185				612	Y	0.56	0.65479	0.2	N	6.1	Y
4	1,554	21		1,168				312	Y	6.39	2.270721	1.2	N	3.08	Y
5	1,554	1.33		1,168				312	Y	6.39	2.270721	1.2	N	3.08	Y
6	2,564	20		843				383	Y	0.39	0.31871	0.7	N	3.12	Y
7	2,564	5		855				383	Y	0.39	0.31871	0.7	N	2.1	Y
8	4,549	0	34	618	7	Y	No UP	680	Y	0.80	0.542933		N	4.5	Y
9	4,549	11		533				680	Y	0.80	0.542933	1.3	N	5.06	Y
10	9,321	0.53		443				1,176	Y	4.29	4.6627	1	Y	4.5	N
11	9,321	1		426				1,176	Y	4.29	4.6627	1	Y	2.4	N
12	5,627	14		845				840	Y	0.41	0.415098	2	N	4.5	Y
13	14,357	9		674				1,483	Y	3.33	3.024747	2.4	Y	2.3	N
14	14,357	0	1	800	7	Y	No UP	1,483	N	3.33	3.024747		Y	0.2	N
15	14,357	5		493				1,483	N	3.33	3.024747	2.4	Y	0.2	N
16	7,921	1.75		1,173				1,407	Y	3.35	4.085617	2	N	3	Y
17	7,921	0.7		1,173				1,407	Y	3.35	4.085617	0.5	N	6	Y

Solution Number	Bridge	Pavement	Mobility	Safety	Freight	Risk Score (0 to 10)				
						Bridge	Pavement	Mobility	Safety	Freight
1	N	N	Y	Y	Y	0.00	0.00	4.60	4.13	3.81
2	N	N	Y	Y	Y	0.00	0.00	7.83	2.08	7.31
3	N	N	Y	Y	Y	0.00	0.00	7.64	2.08	7.31
4	N	N	Y	Y	Y	0.00	0.00	8.41	2.12	7.69
5	N	N	Y	Y	Y	0.00	0.00	7.57	2.12	7.69
6	N	N	Y	Y	Y	0.00	0.00	7.87	2.19	7.16
7	N	Y	Y	Y	Y	0.00	0.62	7.00	2.19	7.16
8	Y	N	Y	N	Y	3.94	0.00	7.50	0.00	7.89
9	N	N	Y	Y	Y	0.00	0.00	8.72	2.30	7.86
10	N	N	Y	Y	Y	0.00	0.00	4.46	4.60	4.79
11	N	Y	Y	Y	Y	0.00	1.86	4.60	4.60	4.79
12	N	N	Y	Y	Y	0.00	0.00	8.74	2.39	7.53
13	N	N	Y	Y	Y	0.00	0.00	5.75	4.85	4.56
14	Y	N	Y	N	Y	2.88	0.00	1.16	0.00	2.06
15	N	Y	Y	Y	Y	0.00	2.46	2.74	4.85	2.06
16	N	N	Y	Y	Y	0.00	0.00	7.94	2.53	8.24
17	N	N	Y	Y	Y	0.00	0.00	7.19	2.13	7.74

APPENDIX E: PERFORMANCE EFFECTIVENESS SCORES

		Solution #	CS95.1	CS95.2	CS95.3	CS95.4A	CS95.4B	CS95.5	CS95.6	CS95.9A	CS95.9B	CS95.10	CS95.12	CS95.13A	CS95.13B	CS95.16A	CS95.16B	CS95.17
		Description	Yuma Area Safety	Fortuna Wash Area Safety	Dome Valley Area Safety	Yuma Proving Ground Area Safety and Freight	Yuma Proving Ground Area Safety and Freight	Yuma Proving Ground Freight	Quartzsite to Bouse Wash Freight	Bouse Wash to Parker Freight	Bouse Wash to Parker Freight	Parker Safety and Freight	Bill Williams River Bridge to Lake Havasu City Safety and Freight	Lake Havasu City Safety and Freight	Lake Havasu City Safety and Freight	Lake Havasu City to I-40 Freight	Lake Havasu City to I-40 Freight	I-40 Approach Freight
		Project Beg MP	29	35	39	59	59	59	111	131	131	142	162	177	177	194.5	196	201.3
		Project End MP	34	39	42	80	80	71	131	142	142	150	177	186	186	196	198	202
		Project Length (miles)	5	4	3	21	21	1.89	20	11	11	0.53	15	9	9	1.5	2	0.7
		Segment Beg MP	29	34	34	60	60	60	111	131	131	142	162	176	176	190	190	190
		Segment End MP	34	42	42	80	80	80	131	142	142	149	176	190	190	202	202	202
		Segment Length (miles)	5	8	8	20	20	20	20	11	11	7	14	14	14	12	12	12
		Segment #	1	2	2	4	4	4	7	8	8	9	11	12	12	13	13	13
		Current # of Lanes (both directions)	4	2	2	2	2	2	2	2	2	4	2	4	4	2	2	2
		Project Type (one-way or two-way)	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way
		Additional Lanes (one-way)	0.25	1.25	0	0	0.5	0	0	0	0.5	0	0.43	0	0	0	0.5	0.5
		Pro-Rated # of Lanes	4.50	3.25	2.00	2.00	3.05	2.00	2.00	2.00	3.00	4.00	2.92	4.00	4.00	2.00	2.17	2.06
		Description																
SAFETY	DIRECTIONAL SAFETY	Orig Segment Directional Safety Index (direction 1)	1.293	2.420	2.420	2.000	2.000	2.000	0.000	0.280	0.280	2.130	1.890	1.630	1.630	1.880	1.880	1.880
		Orig Segment Directional Fatal Crashes (direction 1)	1	2	2	2	2	2	0	0	0	2	2	2	2	2	2	2
		Orig Segment Directional Incap Crashes (direction 1)	2	1	1	2	2	2	0	4	4	3	5	47	47	3	3	3
		Original Fatal Crashes in project limits (direction 1)	1	1	1	2	2	1	0	0	0	2	2	1	1	0	1	0
		Original Incap Crashes in project limits (direction 1)	2	1	0	2	2	0	0	4	4	0	5	37	35	1	1	0
		CMF 1 (direction 1) (lowest CMF)	0.83	0.7	0.64	0.64	0.63	0.7	0.64	0.64	0.63	0.78	1	1	1	0.64	0.63	0.78
		CMF 2 (direction 1)	0.83	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		CMF 3 (direction 1)	0.85	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		CMF 4 (direction 1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		CMF 5 (direction 1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Total CMF (direction 1)	0.702	0.700	0.640	0.640	0.630	0.700	0.640	0.640	0.630	0.780	1.000	1.000	1.000	0.640	0.630	0.780
		Fatal Crash reduction (direction 1)	0.298	0.300	0.360	0.720	0.740	0.300	0.000	0.000	0.000	0.440	0.720	0.634	0.212	0.000	0.370	0.000
		Incap Crash reduction (direction 1)	0.595	0.300	0.000	0.720	0.740	0.000	0.000	1.440	1.480	0.000	2.271	12.786	7.592	0.360	0.370	0.000
		Post-Project Segment Directional Fatal Crashes (direction 1)	0.702	1.700	1.640	1.280	1.260	1.700	0.000	0.000	0.000	1.560	1.280	1.366	1.788	2.000	1.630	2.000
		Post-Project Segment Directional Incap Crashes (direction 1)	1.405	0.700	1.000	1.280	1.260	2.000	0.000	2.560	2.520	3.000	2.729	34.214	39.408	2.640	2.630	3.000
		Post-Project Segment Directional Safety Index (direction 1)	0.908	2.046	2.000	1.281	1.261	1.721	0.000	0.182	0.179	1.702	1.182	1.156	1.398	1.860	1.543	1.880
		Post-Project Segment Directional Safety Index (direction 1)	0.908	2.046	2.000	1.281	1.261	1.721	0.000	0.182	0.179	1.702	1.182	1.156	1.398	1.860	1.543	1.880
		Orig Segment Directional Safety Index (direction 2)	1.312	0.160	0.160	0.950	0.950	0.950	0	0.000	0.000	0.070	1.930	1.910	1.910	0.240	0.240	0.240
		Orig Segment Directional Fatal Crashes (direction 2)	1	0	0	1	1	1	0	0	0	0	2	3	3	0	0	0
		Orig Segment Directional Incap Crashes (direction 2)	2	2	2	0	0	0	0	0	0	1	5	45	45	4	4	4
		Original Fatal Crashes in project limits (direction 2)	1	0	0	1	1	0	0	0	0	0	2	3	3	0	0	0
		Original Incap Crashes in project limits (direction 2)	2	2	0	0	0	0	0	0	0	1	5	33	33	1	0	1
		CMF 1 (direction 2) (Lowest CMF)	0.83	0.7	0.64	0.64	0.63	0.7	0.64	0.64	0.63	0.75	1	1	1	0.64	0.63	0.78
		CMF 2 (direction 2)	0.83	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		CMF 3 (direction 2)	0.85	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		CMF 4 (direction 2)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		CMF 5 (direction 2)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Total CMF (direction 2)	0.702	0.700	0.640	0.640	0.630	0.700	0.640	0.640	0.630	0.750	1.000	1.000	1.000	0.640	0.630	0.780
		Fatal Crash reduction (direction 2)	0.298	0.000	0.000	0.360	0.370	0.000	0.000	0.000	0.000	0.000	0.967	0.974	0.635	0.000	0.000	0.000
		Incap Crash reduction (direction 2)	0.595	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	2.286	10.250	7.169	0.360	0.000	0.220
		Post-Project Segment Directional Fatal Crashes (direction 2)	0.702	0.000	0.000	0.640	0.630	1.000	0.000	0.000	0.000	0.000	1.033	2.026	2.365	0.000	0.000	0.000
		Post-Project Segment Directional Incap Crashes (direction 2)	1.405	1.400	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.750	2.714	34.750	37.831	3.640	4.000	3.780
		Post-Project Segment Directional Safety Index (direction 2)	0.921	0.113	0.161	0.609	0.599	0.951	0.000	0.000	0.000	0.050	1.005	1.384	1.556	0.220	0.236	0.223
		Post-Project Segment Directional Safety Index (direction 2)	0.921	0.113	0.161	0.609	0.599	0.951	0.000	0.000	0.000	0.050	1.005	1.384	1.556	0.220	0.236	0.223
	SAFETY INDEX	Current Safety Index	1.303	1.290	1.290	1.475	1.475	1.475	0.000	0.140	0.140	1.100	1.910	1.770	1.770	1.060	1.060	1.060
		Post-Project Safety Index	0.915	1.080	1.081	0.945	0.930	1.336	0.000	0.091	0.090	0.876	1.094	1.270	1.477	1.040	0.890	1.052
	Needs	Original Segment Safety Need	2.877	3.787	3.787	4.283	4.283	4.283	0.000	0.087	0.087	2.141	6.590	4.771	4.771	2.489	2.489	2.489
		Post-Project Segment Safety Need	0.59	2.807	2.807	0.821	0.8060	3.7620	0.000	0.056	0.055	0.842	3.314	2.831	3.661	2.253	0.857	2.409

			CS95.1	CS95.2	CS95.3	CS95.4A	CS95.4B	CS95.5	CS95.6	CS95.9A	CS95.9B	CS95.10	CS95.12	CS95.13A	CS95.13B	CS95.16A	CS95.16B	CS95.17
		Solution #	CS95.1	CS95.2	CS95.3	CS95.4A	CS95.4B	CS95.5	CS95.6	CS95.9A	CS95.9B	CS95.10	CS95.12	CS95.13A	CS95.13B	CS95.16A	CS95.16B	CS95.17
		Description	Yuma Area Safety	Fortuna Wash Area Safety	Dome Valley Area Safety	Yuma Proving Ground Area Safety and Freight	Yuma Proving Ground Area Safety and Freight	Yuma Proving Ground Freight	Quartzsite to Bouse Wash Freight	Bouse Wash to Parker Freight	Bouse Wash to Parker Freight	Parker Safety and Freight	Bill Williams River Bridge to Lake Havasu City Safety and Freight	Lake Havasu City Safety and Freight	Lake Havasu City Safety and Freight	Lake Havasu City to I-40 Freight	Lake Havasu City to I-40 Freight	I-40 Approach Freight
		Project Beg MP	29	35	39	59	59	59	111	131	131	142	162	177	177	194.5	196	201.3
		Project End MP	34	39	42	80	80	71	131	142	142	150	177	186	186	196	198	202
		Project Length (miles)	5	4	3	21	21	1.89	20	11	11	0.53	15	9	9	1.5	2	0.7
		Segment Beg MP	29	34	34	60	60	60	111	131	131	142	162	176	176	190	190	190
		Segment End MP	34	42	42	80	80	80	131	142	142	149	176	190	190	202	202	202
		Segment Length (miles)	5	8	8	20	20	20	20	11	11	7	14	14	14	12	12	12
		Segment #	1	2	2	4	4	4	7	8	8	9	11	12	12	13	13	13
		Current # of Lanes (both directions)	4	2	2	2	2	2	2	2	2	4	2	4	4	2	2	2
		Project Type (one-way or two-way)	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way
		Additional Lanes (one-way)	0.25	1.25	0	0	0.5	0	0	0	0.5	0	0.43	0	0	0	0.5	0.5
		Pro-Rated # of Lanes	4.50	3.25	2.00	2.00	3.05	2.00	2.00	2.00	3.00	4.00	2.92	4.00	4.00	2.00	2.17	2.06
		Description																
MOBILITY	MOBILITY INDEX	Original Segment Mobility Index	0.350	0.420	0.420	0.120	0.120	0.120	0.210	0.450	0.450	0.320	0.270	0.640	0.640	0.360	0.360	0.360
MOBILITY	MOBILITY INDEX	Post-Project # of Lanes (both directions)	4.50	3.25	2.00	2.00	3.05	2.00	2.00	2.00	3.00	4.00	2.92	4.00	4.00	2.00	2.17	2.06
MOBILITY	MOBILITY INDEX	Post-Project Segment Mobility Index	0.33	0.15	0.42	0.11	0.09	0.12	0.20	0.43	0.32	0.30	0.23	0.61	0.61	0.36	0.34	0.34
MOBILITY	MOBILITY INDEX	Post-Project Segment Mobility Index	0.330	0.150	0.420	0.110	0.090	0.120	0.200	0.430	0.320	0.300	0.230	0.610	0.610	0.360	0.340	0.340
MOBILITY	FUT V/C	Original Segment Future V/C	0.410	0.500	0.500	0.150	0.150	0.150	0.290	0.610	0.610	0.350	0.300	0.830	0.830	0.420	0.420	0.420
MOBILITY	FUT V/C	Post-Project Segment Future V/C	0.390	0.180	0.500	0.130	0.110	0.150	0.270	0.580	0.440	0.330	0.260	0.790	0.790	0.420	0.400	0.400
MOBILITY	FUT V/C	Post-Project Segment Future V/C	0.390	0.180	0.500	0.130	0.110	0.150	0.270	0.580	0.440	0.330	0.260	0.790	0.790	0.420	0.400	0.400
MOBILITY	PEAK HOUR V/C	Original Segment Peak Hour V/C (direction 1)	0.300	0.410	0.410	0.170	0.170	0.170	0.240	0.360	0.360	0.320	0.240	0.420	0.420	0.290	0.290	0.290
MOBILITY	PEAK HOUR V/C	Original Segment Peak Hour V/C (direction 2)	0.290	0.410	0.410	0.170	0.170	0.170	0.250	0.360	0.360	0.360	0.230	0.400	0.400	0.280	0.280	0.280
MOBILITY	PEAK HOUR V/C	Adjusted total # of Lanes for use in directional peak hr	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MOBILITY	PEAK HOUR V/C	Post-Project Segement Peak Hr V/C (direction 1)	0.280	0.15	0.41	0.15	0.12	0.17	0.22	0.34	0.26	0.30	0.22	0.40	0.40	0.29	0.28	0.28
MOBILITY	PEAK HOUR V/C	Post-Project Segement Peak Hr V/C (direction 2)	0.280	0.15	0.41	0.15	0.12	0.17	0.23	0.34	0.26	0.34	0.20	0.38	0.38	0.28	0.27	0.27
MOBILITY	PEAK HOUR V/C	Post-Project Segment Peak Hr V/C (direction 1)	0.280	0.150	0.410	0.150	0.120	0.170	0.220	0.340	0.260	0.300	0.220	0.400	0.400	0.290	0.280	0.280
MOBILITY	PEAK HOUR V/C	Post-Project Segment Peak Hr V/C (direction 2)	0.280	0.150	0.410	0.150	0.120	0.170	0.230	0.340	0.260	0.340	0.200	0.380	0.380	0.280	0.270	0.270
MOBILITY	TTI AND PTI	Safety Reduction Factor	0.702	0.837	0.838	0.641	0.631	1.000	1.000	0.650	0.639	0.796	0.573	0.718	0.834	0.981	0.839	0.992
MOBILITY	TTI AND PTI	Safety Reduction	0.298	0.163	0.162	0.359	0.369	0.000	0.000	0.350	0.361	0.204	0.427	0.282	0.166	0.019	0.161	0.008
MOBILITY	TTI AND PTI	Mobility Reduction Factor	0.943	0.357	1.000	0.917	0.750	1.000	0.952	0.956	0.711	0.938	0.852	0.953	0.953	1.000	0.944	0.944
MOBILITY	TTI AND PTI	Mobility Reduction	0.057	0.643	0.000	0.083	0.250	0.000	0.048	0.044	0.289	0.063	0.148	0.047	0.047	0.000	0.056	0.056
MOBILITY	TTI AND PTI	Original Directional Segment TTI (direction 1)	1.084	1.045	1.045	1.185	1.185	1.185	1.061	1.002	1.002	1.307	1.084	1.240	1.240	1.056	1.056	1.056
MOBILITY	TTI AND PTI	Original Directional Segment PTI (direction 1)	2.964	2.212	2.212	5.364	5.364	5.364	1.315	1.714	1.714	7.350	1.357	4.706	4.706	3.946	3.946	3.946
MOBILITY	TTI AND PTI	Original Directional Segment TTI (direction 2)	1.155	1.000	1.000	1.039	1.039	1.039	1.043	1.000	1.000	1.294	1.051	1.199	1.199	2.006	2.006	2.006
MOBILITY	TTI AND PTI	Original Directional Segment PTI (direction 2)	3.905	1.143	1.143	1.401	1.401	1.401	1.426	1.374	1.374	4.577	1.608	3.783	3.783	7.288	7.288	7.288
MOBILITY	TTI AND PTI	Reduction Factor for Segment TTI	0.017	0.193	0.000	0.025	0.075	0.000	0.014	0.013	0.087	0.019	0.044	0.014	0.014	0.000	0.017	0.017
MOBILITY	TTI AND PTI	Reduction Factor for Segment PTI	0.101	0.178	0.049	0.124	0.161	0.000	0.010	0.114	0.166	0.074	0.158	0.094	0.059	0.006	0.059	0.014
MOBILITY	TTI AND PTI	Post-Project Directional Segment TTI (direction 1)	1.065	1.023	1.045	1.155	1.096	1.185	1.046	1.001	1.001	1.282	1.036	1.100	1.223	1.056	1.038	1.038
MOBILITY	TTI AND PTI	Post-Project Directional Segment PTI (direction 1)	2.665	1.819	2.104	4.696	4.501	4.828	1.184	1.519	1.429	6.809	1.131	3.837	4.428	3.924	3.712	3.893
MOBILITY	TTI AND PTI	Post-Project Directional Segment TTTI (direction 2)	1.135	1.000	1.000	1.013	1.020	1.039	1.028	1.000	1.000	1.270	1.004	1.064	1.182	2.006	1.973	1.973
MOBILITY	TTI AND PTI	Post-Project Directional Segment TPTI (direction 2)	3.511	1.072	1.087	1.227	1.176	1.261	1.283	1.218	1.146	4.240	1.34	3.084	3.560	7.247	6.855	7.189
MOBILITY	CLOSURE EXTENT	Orig Segment Directional Closure Extent (direction 1)	0.369	0.156	0.156	0.030	0.030	0.030	0.370	0.036	0.036	0.514	0.171	0.414	0.457	0.150	0.150	0.150
MOBILITY	CLOSURE EXTENT	Orig Segment Directional Closure Extent (direction 2)	0.120	0.022	0.022	0.010	0.010	0.010	0.080	0.273	0.273	0.029	0.294	0.077	0.091	0.133	0.133	0.133
MOBILITY	CLOSURE EXTENT	Segment Closures with fatalities/injuries	7	5	5	3	3	3	3	2	2	11	18	26	26	9	9	9
MOBILITY	CLOSURE EXTENT	Total Segment Closures	10	8	8	4	4	4	15	7	7	19	28	35	35	17	17	17
MOBILITY	CLOSURE EXTENT	% Closures with Fatality/Injury	0.70	0.63	0.63	0.75	0.75	0.75	0.20	0.29	0.29	0.58	0.64	0.74	0.74	0.53	0.53	0.53
MOBILITY	CLOSURE EXTENT	Closure Reduction	0.209	0.102	0.102	0.269	0.277	0.000	0.000	0.100	0.103	0.118	0.275	0.210	0.123	0.010	0.085	0.004
MOBILITY	CLOSURE EXTENT	Closure Reduction Factor	0.791	0.898	0.898	0.731	0.723	1.000	1.000	0.900	0.897	0.882	0.725	0.790	0.877	0.990	0.915	0.996
MOBILITY	CLOSURE EXTENT	Post-Project Segment Directional Closure Extent (direction 1)	0.292	0.140	0.140	0.022	0.022	0.030	0.210	0.018	0.018	0.453	0.124	0.327	0.401	0.149	0.137	0.149
MOBILITY	CLOSURE EXTENT	Post-Project Segment Directional Closure Extent (direction 2)	0.095	0.020	0.020	0.007	0.007	0.010	0.080	0.273	0.245	0.026	0.213	0.061	0.080	0.132	0.122	0.132
MOBILITY	BICYCLE ACCOM	Orig Segment Bicycle Accomodation %	62.0%	56.0%	56.0%	0.0%	0.0%	0.0%	0.0%	25.0%	25.0%	61.0%	0.0%	9.0%	9.0%	71.0%	71.0%	71.0%
MOBILITY	BICYCLE ACCOM	Orig Segment (Project) Outside Shoulder width	6.0	6.0	6.0	3.0	3.0	3.0	3.0	5.0	5.0	5.0	4.5	1.5	1.5	3.0	6.4	6.4
MOBILITY	BICYCLE ACCOM	Post-Project Segment Outside Shoulder width	10	10	10	10	No Change	No Change	10	10	No Change	No Change	10	No Change	No Change	10	No Change	No Change
MOBILITY	BICYCLE ACCOM	Post-Project Segment Bicycle Accomodation (%)	72.0%	80.0%	80.0%	76.0%	No Change	No Change	77.0%	100.0%	No Change	No Change	99.0%	No Change	No Change	89.0%	No Change	No Change
MOBILITY	BICYCLE ACCOM	Post-Project Segment Bicycle Accomodation (%)	72.0%	80.0%	80.0%	76.0%	No Change	No Change	77.0%	100.0%	No Change	No Change	99.0%	No Change	No Change	89.0%	No Change	No Change
MOBILITY	Needs	Original Segment Mobility Need	0.937	1.813	1.813	4.101	4.101	4.101	1.221	1.667	1.667	1.312	1.485	1.828	1.828	8.110	8.110	8.110
MOBILITY	Needs	Post-Project Segment Mobility Need	0.765	0.857	1.388	3.048	3.393	3.694	0.616	0.873	1.272	1.195	0.486	1.489	1.590	7.833	7.550	7.939

		Solution #	CS95.1	CS95.2	CS95.3	CS95.4A	CS95.4B	CS95.5	CS95.6	CS95.9A	CS95.9B	CS95.10	CS95.12	CS95.13A	CS95.13B	CS95.16A	CS95.16B	CS95.17
		Description	Yuma Area Safety	Fortuna Wash Area Safety	Dome Valley Area Safety	Yuma Proving Ground Area Safety and Freight	Yuma Proving Ground Area Safety and Freight	Yuma Proving Ground Freight	Quartzsite to Bouse Wash Freight	Bouse Wash to Parker Freight	Bouse Wash to Parker Freight	Parker Safety and Freight	Bill Williams River Bridge to Lake Havasu City Safety and Freight	Lake Havasu City Safety and Freight	Lake Havasu City Safety and Freight	Lake Havasu City to I-40 Freight	Lake Havasu City to I-40 Freight	I-40 Approach Freight
		Project Beg MP	29	35	39	59	59	59	111	131	131	142	162	177	177	194.5	196	201.3
		Project End MP	34	39	42	80	80	71	131	142	142	150	177	186	186	196	198	202
		Project Length (miles)	5	4	3	21	21	1.89	20	11	11	0.53	15	9	9	1.5	2	0.7
		Segment Beg MP	29	34	34	60	60	60	111	131	131	142	162	176	176	190	190	190
		Segment End MP	34	42	42	80	80	80	131	142	142	149	176	190	190	202	202	202
		Segment Length (miles)	5	8	8	20	20	20	20	11	11	7	14	14	14	12	12	12
		Segment #	1	2	2	4	4	4	7	8	8	9	11	12	12	13	13	13
		Current # of Lanes (both directions)	4	2	2	2	2	2	2	2	2	4	2	4	4	2	2	2
		Project Type (one-way or two-way)	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way
		Additional Lanes (one-way)	0.25	1.25	0	0	0.5	0	0	0	0.5	0	0.43	0	0	0	0.5	0.5
		Pro-Rated # of Lanes	4.50	3.25	2.00	2.00	3.05	2.00	2.00	2.00	3.00	4.00	2.92	4.00	4.00	2.00	2.17	2.06
		Description																
FREIGHT	TTTI AND TPTI	Original Directional Segment TTTI (direction 1)	1.154	1.083	1.083	1.285	1.285	1.285	1.097	1.042	1.042	1.406	1.185	1.320	1.320	1.305	1.305	1.305
FREIGHT	TTTI AND TPTI	Original Directional Segment TPTI (direction 1)	3.702	2.034	2.034	13.661	13.661	13.661	1.459	2.217	2.217	7.042	1.560	5.291	5.291	3.089	3.089	3.089
FREIGHT	TTTI AND TPTI	Original Directional Segment TTTI (direction 2)	1.188	1.000	1.000	1.108	1.108	1.108	1.091	1.018	1.018	1.325	1.103	1.281	1.281	2.741	2.741	2.741
FREIGHT	TTTI AND TPTI	Original Directional Segment TPTI (direction 2)	3.318	1.169	1.169	1.521	1.521	1.521	1.501	1.436	1.436	4.270	1.550	3.964	3.964	7.659	7.659	7.659
FREIGHT	TTTI AND TPTI	Reduction Factor for Segment TTTI (both directions)	0.009	0.096	0.000	0.013	0.038	0.000	0.007	0.007	0.043	0.009	0.022	0.007	0.007	0.000	0.008	0.008
FREIGHT	TTTI AND TPTI	Reduction Factor for Segment TPTI (both directions)	0.050	0.089	0.024	0.062	0.080	0.000	0.005	0.057	0.083	0.037	0.079	0.047	0.030	0.003	0.030	0.007
FREIGHT	TTTI AND TPTI	Post-Project Directional Segment TTTI (direction 1)	1.144	1.031	1.083	1.269	1.237	1.285	1.089	1.035	1.019	1.393	1.159	1.180	1.311	1.305	1.294	1.294
FREIGHT	TTTI AND TPTI	Post-Project Directional Segment TPTI (direction 1)	3.515	1.853	1.984	12.811	12.562	12.295	1.313	2.091	2.033	6.783	1.437	4.538	5.135	3.080	2.997	3.068
FREIGHT	TTTI AND TPTI	Post-Project Directional Segment TTTI (direction 2)	1.178	1.000	1.000	1.094	1.066	1.108	1.083	1.011	1.009	1.313	1.078	1.145	1.272	2.741	2.718	2.718
FREIGHT	TTTI AND TPTI	Post-Project Directional Segment TPTI (direction 2)	3.151	1.065	1.141	1.426	1.399	1.369	1.351	1.354	1.317	4.113	1.428	3.400	3.847	7.637	7.432	7.607
FREIGHT	FREIGHT INDEX	Original Segment TPTI (direction 1)	3.702	2.034	2.034	13.661	13.661	13.661	1.459	2.217	2.217	7.042	1.560	5.291	5.291	3.089	3.089	3.089
FREIGHT	FREIGHT INDEX	Original Segment TPTI (direction 2)	3.318	1.169	1.169	1.521	1.521	1.521	1.501	1.436	1.436	4.270	1.550	3.964	3.964	7.659	7.659	7.659
FREIGHT	FREIGHT INDEX	Original Segment Freight Index	0.285	0.624	0.624	0.132	0.132	0.132	0.676	0.547	0.547	0.177	0.643	0.216	0.216	0.186	0.186	0.186
FREIGHT	FREIGHT INDEX	Post-Project Segment TPTI (direction 1)	3.515	1.853	1.984	12.811	12.562	12.295	1.313	2.091	2.033	6.783	1.437	4.538	5.135	3.080	2.997	3.068
FREIGHT	FREIGHT INDEX	Post-Project Segment TPTI (direction 2)	3.151	1.065	1.141	1.426	1.399	1.369	1.351	1.354	1.317	4.113	1.428	3.400	3.847	7.637	7.432	7.607
FREIGHT	FREIGHT INDEX	Post-Project Segment Freight Index	0.300	0.685	0.640	0.140	0.143	0.146	0.751	0.581	0.597	0.184	0.698	0.252	0.223	0.187	0.192	0.187
FREIGHT	CLOSURE DURATION	Orig Segment Directional Closure Duration (dir 1)	117.614	27.889	27.889	10.180	10.180	10.180	133.600	10.127	10.127	106.457	27.943	49.729	67.300	18.233	18.233	18.233
FREIGHT	CLOSURE DURATION	Orig Segment Directional Closure Duration (dir 2)	14.880	3.622	3.622	2.190	2.190	2.190	7.490	166.291	166.291	22.771	53.849	10.054	11.797	20.917	20.917	20.917
FREIGHT	CLOSURE DURATION	Segment Closures with fatalities	7	5	5	3	3	3	3	2	2	11	18	26	26	9	9	9
FREIGHT	CLOSURE DURATION	Total Segment Closures	10	8	8	4	4	4	15	7	7	19	28	35	35	17	17	17
FREIGHT	CLOSURE DURATION	% Closures with Fatality	0.70	0.63	0.63	0.75	0.75	0.75	0.20	0.29	0.29	0.58	0.64	0.74	0.74	0.53	0.53	0.53
FREIGHT	CLOSURE DURATION	Closure Reduction	0.209	0.102	0.102	0.269	0.277	0.000	0.000	0.100	0.103	0.118	0.275	0.210	0.123	0.010	0.085	0.004
FREIGHT	CLOSURE DURATION	Closure Reduction Factor	0.791	0.898	0.898	0.731	0.723	1.000	1.000	0.900	0.897	0.882	0.725	0.790	0.877	0.990	0.915	0.996
FREIGHT	CLOSURE DURATION	Post-Project Segment Directional Closure Duration (direction 1)	93.089	25.045	25.058	7.437	7.359	10.180	68.270	9.114	9.083	93.906	20.264	39.294	59.024	18.051	16.680	18.156
FREIGHT	CLOSURE DURATION	Post-Project Segment Directional Closure Duration (direction 2)	11.777	3.253	3.254	1.600	1.583	2.190	7.490	149.662	149.153	20.086	39.051	7.944	10.346	20.708	19.136	20.828
FREIGHT	VERT CLR	Original Segment Vertical Clearance	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	27.83	No UP	16.41	16.41	No UP	No UP	No UP
FREIGHT	VERT CLR	Original vertical clearance for specific bridge	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	27.83	No UP	16.41	16.41	No UP	No UP	No UP
FREIGHT	VERT CLR	Post-Project vertical clearance for specific bridge	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	27.83	No UP	16.41	16.41	No UP	No UP	No UP
FREIGHT	VERT CLR	Post-Project Segment Vertical Clearance	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	27.83	No UP	16.41	16.41	No UP	No UP	No UP
FREIGHT	VERT CLR	Post-Project Segment Vertical Clearance	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	No UP	27.83	No UP	16.41	16.41	No UP	No UP	No UP
FREIGHT	**Needs**	Original Segment Freight Need	0.822	3.275	3.275	13.048	13.048	13.048	2.595	3.903	3.903	2.536	3.040	1.999	1.999	11.003	11.003	11.003
FREIGHT	**Needs**	Post-Project Segment Freight Need	0.69	2.383	3.211	12.303	12.017	11.839	0.633	3.622	3.55	2.406	2.009	1.295	1.918	10.978	10.724	10.918

		Solution #	CS95.1	CS95.2	CS95.3	CS95.4A	CS95.4B	CS95.5	CS95.6	CS95.9A	CS95.9B	CS95.10	CS95.12	CS95.13A	CS95.13B	CS95.16A	CS95.16B	CS95.17
		Description	Yuma Area Safety	Fortuna Wash Area Safety	Dome Valley Area Safety	Yuma Proving Ground Area Safety and Freight	Yuma Proving Ground Area Safety and Freight	Yuma Proving Ground Freight	Quartzsite to Bouse Wash Freight	Bouse Wash to Parker Freight	Bouse Wash to Parker Freight	Parker Safety and Freight	Bill Williams River Bridge to Lake Havasu City Safety and Freight	Lake Havasu City Safety and Freight	Lake Havasu City Safety and Freight	Lake Havasu City to I-40 Freight	Lake Havasu City to I-40 Freight	I-40 Approach Freight
		Project Beg MP	29	35	39	59	59	59	111	131	131	142	162	177	177	194.5	196	201.3
		Project End MP	34	39	42	80	80	71	131	142	142	150	177	186	186	196	198	202
		Project Length (miles)	5	4	3	21	21	1.89	20	11	11	0.53	15	9	9	1.5	2	0.7
		Segment Beg MP	29	34	34	60	60	60	111	131	131	142	162	176	176	190	190	190
		Segment End MP	34	42	42	80	80	80	131	142	142	149	176	190	190	202	202	202
		Segment Length (miles)	5	8	8	20	20	20	20	11	11	7	14	14	14	12	12	12
		Segment #	1	2	2	4	4	4	7	8	8	9	11	12	12	13	13	13
		Current # of Lanes (both directions)	4	2	2	2	2	2	2	2	2	4	2	4	4	2	2	2
		Project Type (one-way or two-way)	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way	two-way
		Additional Lanes (one-way)	0.25	1.25	0	0	0.5	0	0	0	0.5	0	0.43	0	0	0	0.5	0.5
		Pro-Rated # of Lanes	4.50	3.25	2.00	2.00	3.05	2.00	2.00	2.00	3.00	4.00	2.92	4.00	4.00	2.00	2.17	2.06
		Description																
BRIDGE	BRIDGE INDEX	Original Segment Bridge Index	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original lowest rating for specific bridge	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project lowest rating for specific bridge	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project lowest rating for specific bridge	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bridge Index	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bridge Index	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	SUFF RATING	Original Segment Sufficiency Rating	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original Sufficiency Rating for specific bridge	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Sufficiency Rating for specific bridge	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Sufficiency Rating for specific bridge	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Sufficiency Rating	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Sufficiency Rating	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	BR RTNG	Original Segment Bridge Rating	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bridge Rating	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bridge Rating	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	% FUN OB	Original Segment % Functionally Obsolete	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment % Functionally Obsolete	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment % Functionally Obsolete	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Needs	Original Segment Bridge Need	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Bridge Need	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
PAVEMENT	PAVEMENT INDEX	Original Segment Pavement Index	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original Segment IRI in project limits	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original Segment Cracking in project limits	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project IRI in project limits	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project IRI in project limits	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Cracking in project limits	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Cracking in project limits	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Pavement Index	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Pavement Index	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	DIRECTION PSR	Original Segment Directional PSR (direction 1)	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original Segment Directional PSR (direction 2)	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Original Segment IRI in project limits	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project directional IRI in project limits	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Directional PSR (direction 1)	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Directional PSR (direction 2)	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Directional PSR (direction 1)	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Directional PSR (direction 2)	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	% FAIL	Original Segment % Failure	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment % Failure	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment % Failure	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Needs	Original Segment Pavement Need	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
		Post-Project Segment Pavement Need	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change

Performance Area Scoring

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Pavement					Bridge					Safety					Mobility					Freight					Total Risk Factored Performance Area Benefit
				Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	Existing Segment Need	Post-Solution Segment Need	Raw Score	Risk Factor	Factored Score	
CS95.1	Yuma Area Safety	29-34	15.41			0.000		0.000			0.000		0.000	2.877	0.590	2.287	4.13	9.435	0.937	0.765	0.172	4.60	0.791	0.822	0.690	0.132	3.81	0.502	10.728
CS95.2	Fortuna Wash Area Safety Improvements	35-39	17.24			0.000		0.000			0.000		0.000	3.787	2.807	0.980	2.08	2.038	1.813	0.857	0.956	7.83	7.483	3.275	2.383	0.892	7.31	6.517	16.038
CS95.3	Dome Valley Area Safety	39-42	3.46			0.000		0.000			0.000		0.000	3.787	2.807	0.980	2.08	2.038	1.813	1.388	0.425	7.64	3.248	3.275	3.211	0.064	7.31	0.468	5.753
CS95.4A	Yuma Proving Ground Area Safety and Freight	59-80	31.00			0.000		0.000			0.000		0.000	4.283	0.821	3.462	2.12	7.327	4.101	3.048	1.053	8.41	8.857	13.048	12.303	0.745	7.69	5.728	21.912
CS95.4B	Yuma Proving Ground Area Safety and Freight	59-80	79.61			0.000		0.000			0.000		0.000	4.283	0.806	3.477	2.12	7.359	4.101	3.393	0.708	8.41	5.955	13.048	12.017	1.031	7.69	7.927	21.241
CS95.5	Yuma Proving Ground Freight Improvements	59-71	10.74			0.000		0.000			0.000		0.000	4.283	3.762	0.521	2.12	1.103	4.101	3.694	0.407	7.57	3.081	13.048	11.839	1.209	7.69	9.296	13.480
CS95.6	Quartzsite to Bouse Wash Freight	111-123	52.44			0.000		0.000			0.000		0.000	0.000	0.000	0.000	2.19	0.000	1.221	0.616	0.605	7.87	4.760	2.595	0.633	1.962	7.16	14.044	18.803
CS95.9A	Bouse Wash to Parker Freight	131-142	15.13			0.000		0.000			0.000		0.000	0.087	0.056	0.031	2.30	0.071	1.667	0.873	0.794	8.72	6.925	3.903	3.622	0.281	7.86	2.209	9.206
CS95.9B	Bouse Wash to Parker Freight	131-142	43.07			0.000		0.000			0.000		0.000	0.087	0.055	0.032	2.30	0.074	1.667	1.272	0.395	8.72	3.445	3.903	3.550	0.353	7.86	2.775	6.294
CS95.10	Parker Safety and Freight	142-150	2.65			0.000		0.000			0.000		0.000	2.141	0.842	1.299	4.60	5.982	1.312	1.195	0.117	4.46	0.522	2.536	2.406	0.130	4.79	0.623	7.126
CS95.12	Bill Williams River Bridge to Lake Havasu City Safety and Freight	164-177	56.31			0.000		0.000			0.000		0.000	6.590	3.314	3.276	2.39	7.832	1.485	0.486	0.999	8.74	8.730	3.040	2.009	1.031	7.53	7.766	24.327
CS95.13A	Lake Havasu City Safety and Freight	177-186	50.91			0.000		0.000			0.000		0.000	4.771	2.831	1.940	4.85	9.412	1.828	1.489	0.339	5.75	1.949	1.999	1.295	0.704	4.56	3.209	14.570
CS95.13B	Lake Havasu City Safety and Freight	177-186	16.99			0.000		0.000			0.000		0.000	4.771	3.661	1.110	4.85	5.385	1.828	1.590	0.238	5.75	1.368	1.999	1.918	0.081	4.56	0.369	7.123
CS95.16A	Lake Havasu City to I-40 Freight	194.5-196	2.26			0.000		0.000			0.000		0.000	2.489	2.253	0.236	2.53	0.596	8.110	7.833	0.277	7.94	2.201	11.003	10.978	0.025	8.24	0.206	3.004
CS95.16B	Lake Havasu City to I-40 Freight	196-198	7.56			0.000		0.000			0.000		0.000	2.489	0.857	1.632	2.53	4.124	8.110	7.550	0.560	7.94	4.448	11.003	10.724	0.279	8.24	2.300	10.872
CS95.17	I-40 Approach Freight	201.3-202	3.25			0.000		0.000			0.000		0.000	2.489	2.409	0.080	2.13	0.170	8.110	7.939	0.171	7.19	1.231	11.003	10.918	0.085	7.74	0.658	2.059

Performance Effectiveness Scoring

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Safety Emphasis Area						Mobility Emphasis Area						Freight Emphasis Area					
				Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score	Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score	Existing Corridor Need	Post-Solution Corridor Need	Raw Score	Risk Factor	Emphasis Factor	Factored Score
CS95.1	Yuma Area Safety	29-34	15.41	2.308	2.164	0.144	4.13	1.50	0.891	0.267	0.267	0.000	4.60	1.50	0.002	2.623	2.622	0.001	3.81	1.50	0.004
CS95.2	Fortuna Wash Area Safety Improvements	35-39	17.24	2.308	2.166	0.142	2.08	1.50	0.443	0.267	0.253	0.014	7.83	1.50	0.167	2.623	2.617	0.005	7.31	1.50	0.060
CS95.3	Dome Valley Area Safety	39-42	3.46	2.308	2.167	0.141	2.08	1.50	0.440	0.267	0.267	0.000	7.64	1.50	0.000	2.623	2.621	0.001	7.31	1.50	0.015
CS95.4A	Yuma Proving Ground Area Safety and Freight	59-80	31.00	2.308	1.516	0.792	2.12	1.50	2.514	0.267	0.265	0.002	8.41	1.50	0.026	2.623	2.621	0.002	7.69	1.50	0.019
CS95.4B	Yuma Proving Ground Area Safety and Freight	59-80	79.61	2.308	0.500	1.808	2.12	1.50	5.740	0.267	0.263	0.004	8.41	1.50	0.055	2.623	2.620	0.002	7.69	1.50	0.026
CS95.5	Yuma Proving Ground Freight Improvements	59-71	10.74	2.308	2.106	0.202	2.12	1.50	0.641	0.267	0.267	0.000	7.57	1.50	0.000	2.623	2.620	0.003	7.69	1.50	0.033
CS95.6	Quartzsite to Bouse Wash Freight	111-123	52.44	2.308	2.308	0.000	2.19	1.50	0.000	0.267	0.265	0.002	7.87	1.50	0.024	2.623	2.607	0.016	7.16	1.50	0.168
CS95.9A	Bouse Wash to Parker Freight	131-142	15.13	2.308	2.266	0.042	2.30	1.50	0.145	0.267	0.265	0.002	8.72	1.50	0.030	2.623	2.619	0.004	7.86	1.50	0.044
CS95.9B	Bouse Wash to Parker Freight	131-142	43.07	2.308	2.265	0.043	2.30	1.50	0.148	0.267	0.258	0.009	8.72	1.50	0.120	2.623	2.617	0.005	7.86	1.50	0.065
CS95.10	Parker Safety and Freight	142-150	2.65	2.308	2.210	0.098	4.60	1.50	0.677	0.267	0.267	0.000	4.46	1.50	0.003	2.623	2.622	0.000	4.79	1.50	0.003
CS95.12	Bill Williams River Bridge to Lake Havasu City Safety and Freight	164-177	56.31	2.308	0.498	1.810	2.39	1.50	6.492	0.267	0.264	0.003	8.74	1.50	0.039	2.623	2.615	0.008	7.53	1.50	0.088
CS95.13A	Lake Havasu City Safety and Freight	177-186	50.91	2.308	1.789	0.519	4.85	1.50	3.780	0.267	0.264	0.003	5.75	1.50	0.026	2.623	2.618	0.005	4.56	1.50	0.035
CS95.13B	Lake Havasu City Safety and Freight	177-186	16.99	2.308	2.005	0.303	4.85	1.50	2.208	0.267	0.264	0.003	5.75	1.50	0.026	2.623	2.622	0.001	4.56	1.50	0.007
CS95.16A	Lake Havasu City to I-40 Freight	194.5-196	2.26	2.308	2.292	0.016	2.53	1.50	0.061	0.267	0.267	0.000	7.94	1.50	0.000	2.623	2.623	0.000	8.24	1.50	0.001
CS95.16B	Lake Havasu City to I-40 Freight	196-198	7.56	2.308	2.158	0.150	2.53	1.50	0.569	0.267	0.265	0.002	7.94	1.50	0.022	2.623	2.622	0.001	8.24	1.50	0.008
CS95.17	I-40 Approach Freight	201.3-202	3.25	2.308	2.302	0.006	2.13	1.50	0.019	0.267	0.265	0.002	7.19	1.50	0.020	2.623	2.623	0.000	7.74	1.50	0.000

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Total Factored Benefit	VMT Factor	NPV Factor	Performance Effectiveness Score
CS95.1	Yuma Area Safety	29-34	15.41	11.625	2.41	20.2	36.8
CS95.2	Fortuna Wash Area Safety Improvements	35-39	17.24	16.708	1.76	20.2	34.4
CS95.3	Dome Valley Area Safety	39-42	3.46	6.208	1.39	15.3	38.1
CS95.4A	Yuma Proving Ground Area Safety and Freight	59-80	31.00	24.472	1.82	15.3	22.0
CS95.4B	Yuma Proving Ground Area Safety and Freight	59-80	79.61	27.062	1.82	20.2	12.5
CS95.5	Yuma Proving Ground Freight Improvements	59-71	10.74	14.154	0.20	20.2	5.3
CS95.6	Quartzsite to Bouse Wash Freight	111-123	52.44	18.995	2.55	20.2	18.6
CS95.9A	Bouse Wash to Parker Freight	131-142	15.13	9.425	2.51	20.2	31.5
CS95.9B	Bouse Wash to Parker Freight	131-142	43.07	6.628	2.51	20.2	7.8
CS95.10	Parker Safety and Freight	142-150	2.65	7.810	0.33	15.3	15.1
CS95.12	Bill Williams River Bridge to Lake Havasu City Safety and Freight	164-177	56.31	30.946	3.45	20.2	38.3
CS95.13A	Lake Havasu City Safety and Freight	177-186	50.91	18.410	4.17	20.2	30.5
CS95.13B	Lake Havasu City Safety and Freight	177-186	16.99	9.363	4.17	15.3	35.2
CS95.16A	Lake Havasu City to I-40 Freight	194.5-196	2.26	3.066	0.76	15.3	15.8
CS95.16B	Lake Havasu City to I-40 Freight	196-198	7.56	11.471	0.99	20.2	30.3
CS95.17	I-40 Approach Freight	201.3-202	3.25	2.098	0.37	20.2	4.8

miles	2014 ADT	1-way or 2-way	VMT
5.00	9480	2	47400
4.00	7782	2	31128
3.00	7782	2	23346
21.00	1554	2	32634
21.00	1554	2	32634
1.89	1554	2	2937.06
20.00	2564	2	51280
11.00	4549	2	50039
11.00	4549	2	50039
0.53	9321	2	4978.2614
15.00	5627	2	84405
9.00	14357	2	129213
9.00	14357	2	129213
1.50	7921	2	11881.5
2.00	7921	2	15842
0.70	7921	2	5544.7

APPENDIX F: SOLUTION PRIORITIZATION SCORES

Candidate Solution #	Candidate Solution Name	Milepost Location	Estimated Cost ($ millions)	Pavement		Bridge		Safety		Mobility		Freight		Total Factored Score	Risk Factors					Weighted Risk Factor	Segment Need	Prioritization Score
				Score	%	Score	%	Score	%	Score	%	Score	%		Pavement	Bridge	Safety	Mobility	Freight			
CS95.1	Yuma Area Safety	29-34	15.41	0.000	0.0%	0.000	0.0%	10.326	88.8%	0.793	6.8%	0.507	4.4%	11.625	1.14	1.51	1.78	1.36	1.36	1.733	0.923	**59**
CS95.2	Fortuna Wash Area Safety Improvements	35-39	17.24	0.000	0.0%	0.000	0.0%	2.481	14.8%	7.650	45.8%	6.577	39.4%	16.708	1.14	1.51	1.78	1.36	1.36	1.422	1.615	**79**
CS95.3	Dome Valley Area Safety	39-42	3.46	0.000	0.0%	0.000	0.0%	2.477	39.9%	3.248	52.3%	0.483	7.8%	6.208	1.14	1.51	1.78	1.36	1.36	1.528	1.615	**94**
CS95.4A	Yuma Proving Ground Area Safety and Freight	59-80	31.00	0.000	0.0%	0.000	0.0%	9.842	40.2%	8.883	36.3%	5.747	23.5%	24.472	1.14	1.51	1.78	1.36	1.36	1.529	1.615	**54**
CS95.4B	Yuma Proving Ground Area Safety and Freight	59-80	79.61	0.000	0.0%	0.000	0.0%	13.099	48.4%	6.010	22.2%	7.953	29.4%	27.062	1.14	1.51	1.78	1.36	1.36	1.563	1.615	**32**
CS95.5	Yuma Proving Ground Freight Improvements	59-71	10.74	0.000	0.0%	0.000	0.0%	1.744	12.3%	3.081	21.8%	9.329	65.9%	14.154	1.14	1.51	1.78	1.36	1.36	1.412	1.615	**12**
CS95.6	Quartzsite to Bouse Wash Freight	111-123	52.44	0.000	0.0%	0.000	0.0%	0.000	0.0%	4.784	25.2%	14.212	74.8%	18.995	1.14	1.51	1.78	1.36	1.36	1.360	0.923	**23**
CS95.9A	Bouse Wash to Parker Freight	131-142	15.13	0.000	0.0%	0.000	0.0%	0.216	2.3%	6.955	73.8%	2.253	23.9%	9.425	1.14	1.51	1.78	1.36	1.36	1.370	1.615	**70**
CS95.9B	Bouse Wash to Parker Freight	131-142	43.07	0.000	0.0%	0.000	0.0%	0.222	3.3%	3.566	53.8%	2.840	42.9%	6.628	1.14	1.51	1.78	1.36	1.36	1.374	1.615	**17**
CS95.10	Parker Safety and Freight	142-150	2.65	0.000	0.0%	0.000	0.0%	6.658	85.3%	0.525	6.7%	0.626	8.0%	7.810	1.14	1.51	1.78	1.36	1.36	1.718	1.538	**40**
CS95.12	Bill Williams River Bridge to Lake Havasu City Safety and Freight	164-177	56.31	0.000	0.0%	0.000	0.0%	14.324	46.3%	8.769	28.3%	7.853	25.4%	30.946	1.14	1.51	1.78	1.36	1.36	1.554	1.385	**83**
CS95.13A	Lake Havasu City Safety and Freight	177-186	50.91	0.000	0.0%	0.000	0.0%	13.191	71.7%	1.975	10.7%	3.244	17.6%	18.410	1.14	1.51	1.78	1.36	1.36	1.661	1.846	**93**
CS95.13B	Lake Havasu City Safety and Freight	177-186	16.99	0.000	0.0%	0.000	0.0%	7.593	81.1%	1.394	14.9%	0.376	4.0%	9.363	1.14	1.51	1.78	1.36	1.36	1.701	1.846	**110**
CS95.16A	Lake Havasu City to I-40 Freight	194.5-196	2.26	0.000	0.0%	0.000	0.0%	0.657	21.4%	2.201	71.8%	0.207	6.8%	3.066	1.14	1.51	1.78	1.36	1.36	1.450	1.154	**26**
CS95.16B	Lake Havasu City to I-40 Freight	196-198	7.56	0.000	0.0%	0.000	0.0%	4.693	40.9%	4.469	39.0%	2.308	20.1%	11.471	1.14	1.51	1.78	1.36	1.36	1.532	1.154	**54**
CS95.17	I-40 Approach Freight	201.3-202	3.25	0.000	0.0%	0.000	0.0%	0.189	9.0%	1.251	59.6%	0.658	31.4%	2.098	1.14	1.51	1.78	1.36	1.36	1.398	1.154	**8**